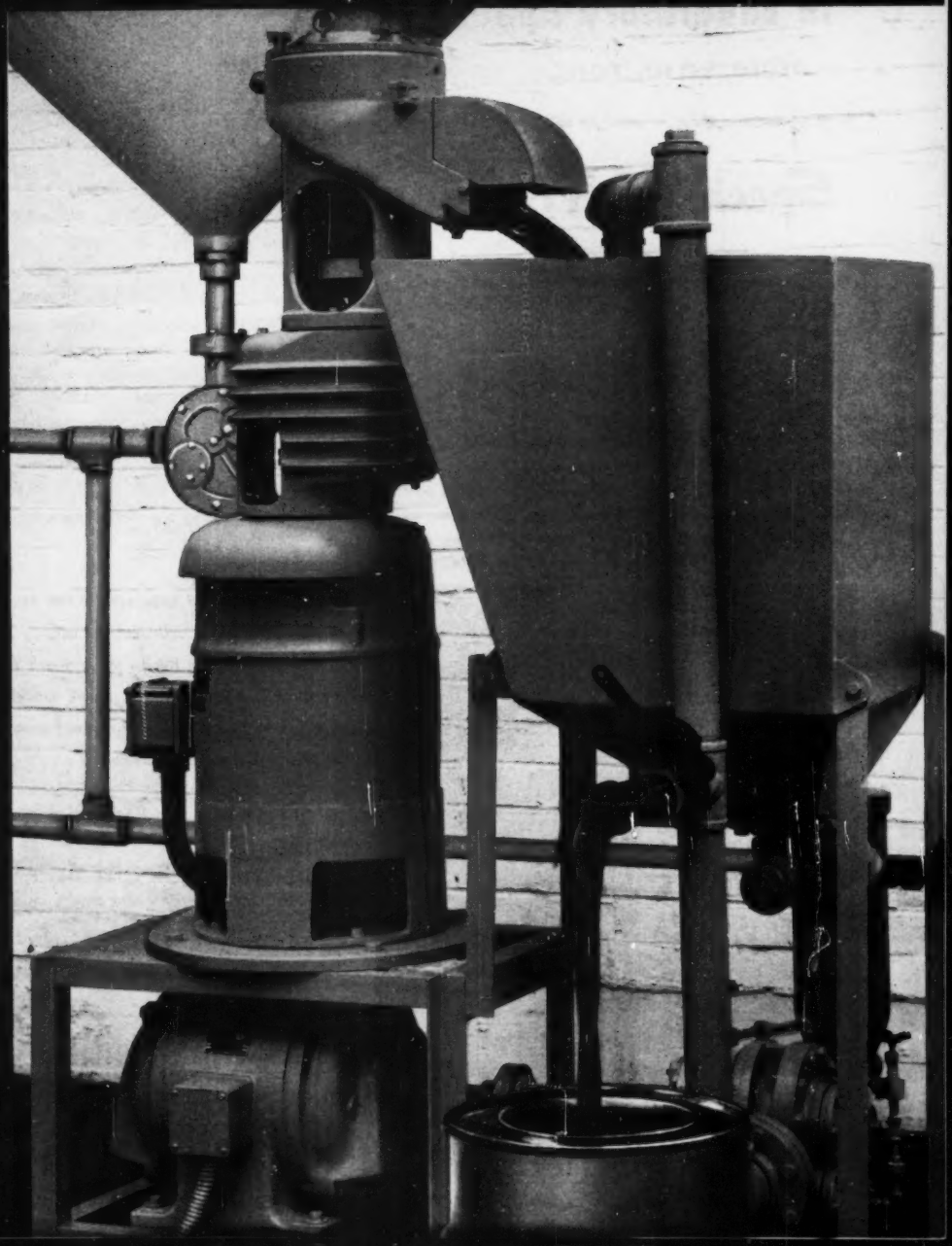
The Spokesman



OFFICIAL PUBLICATION

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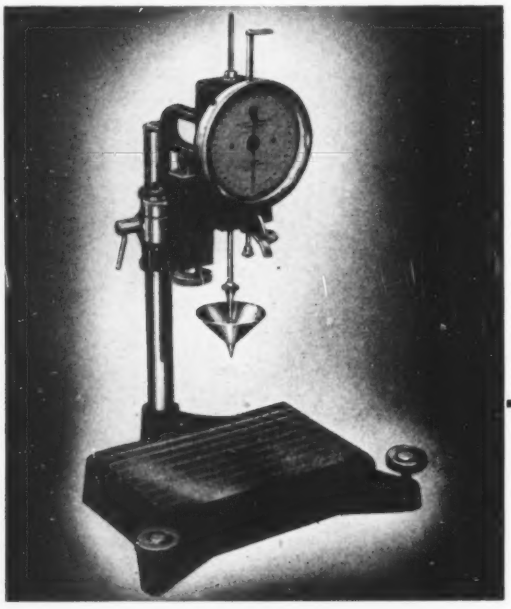

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DOW CORNING

Silicone Notes

ON LUBRICATION

REFERENCE NO. SL-51

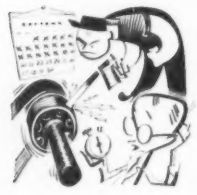
FILE SILICONE LUBRICANTS

Make sure you have basic data sheets BG-2, 5502, 7101. If misplaced write Department N-9

DOW CORNING CORPORATION
Midland, Michigan

DOW CORNING 44 GREASE

791 HOURS AT 400° F. plus 2033 hours of operation at 300° F. were ticked off before we reached an end point in testing bearings lubricated with Dow Corning 44 Silicone Grease. We used heat-treated, steel retainer bearings operating at 1750 rpm under a spring load of 150 pounds. After 250 eight-hour days at 300° F., we pushed the temperature up to 400°. 791 hours later the bearing failed. That's at least 10 times the maximum life recorded for any organic grease tested at 400° F.



AFTER 754 HOURS at 390°, 365° and 330° F. respectively, the life testing of Dow Corning 44 Grease in 3 similar bearings operating at the same speed under the same load was discontinued. Only the 390° bearing showed sign of failure. Under the same conditions, other bearings were operated at 385° F. for 814 hours and at 390° F. for 774 hours. The bearings were just beginning to be noisy.

RESULTS OF OUR LIFE TESTING at 350-400° F. have been confirmed by independent investigators. We feel justified, therefore, in raising the maximum operating temperature suggested for Dow Corning 44 Silicone Grease from 350° to 400° F. Maximum speed factor (mm. bore x rpm) remains at 150,000-225,000.

ANNEALING OVENS AT 1400° F. are located only 2 feet from bearings on motor directly coupled to forced draft fans. In spite of frequent relubrication with organic greases these bearings had a service life of about 6 months. The electrical foreman finally installed bearings prelubricated with Dow Corning 44 Grease. These bearings have never been relubricated and they are still in service after about 2 years of operation.

DOW CORNING SILICONE OILS

METAL COMBINATIONS now commonly used in bearings were developed to give maximum service with conventional lubricants. They are the result of years of Edisonian research. Yet many people assume that the lubricant is incidental; expect a synthetic lubricant to perform equally well between metals carefully selected for use with petroleum oils of radically different chemical structure. That's a fallacy that may lead to trouble in the use of synthetic lubricants, including our silicone oils and greases.

RELATIVELY CONSTANT VISCOSITY over a wide temperature span, exceptional heat stability and oxidation resistance are properties peculiar to our silicone fluids. And those are among the properties required of an ideal lubricant. The ability to reduce wear and friction is the other basic property and that depends in large measure on the metal combinations. Here's some data on the relative effectiveness of various silicone fluids as lubricants for various metal combinations.

METAL COMBINATION	*Dow Corning 200*	*Dow Corning 550*	*Dow Corning 710*
Cast iron—bronze	Good	Good	Good
Cast iron—steel	Poor	Poor	Poor
Bronze—nylon	Good	Good	Good
Steel—aluminum	Poor	Poor	Poor
Steel—babbitt	Good	Poor	Poor
Steel—bronze	Good	Good	Poor
Steel—cadmium	Good	Good	Good
Steel—chrome	VARIABLE RESULTS		
Steel—nylon	Good	Good	Good
Steel—steel	Poor	Poor	Poor
Steel—zinc	Good	Good	Good

These data were obtained with a Falex lubricant test machine under boundary or extreme pressure conditions. They are presented here only as a guide in selecting metal combinations to give maximum life with various Dow Corning Silicone Fluids. Careful breaking-in of bearing surfaces may be required.

TWO YEARS vs. 36 HOURS. That's the relative life of a few drops of Dow Corning 710 Fluid compared with any other lubricant tested in a clock motor fully exposed to the atmosphere.

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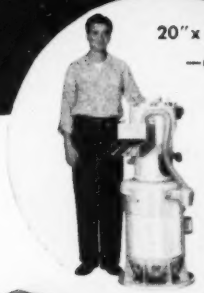
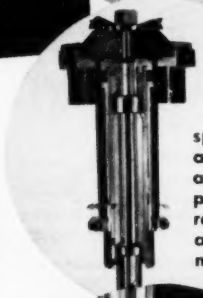
YOU GET MORE WITH MOREHOUSE

Spline driven rotor assembly simplifies maintenance.

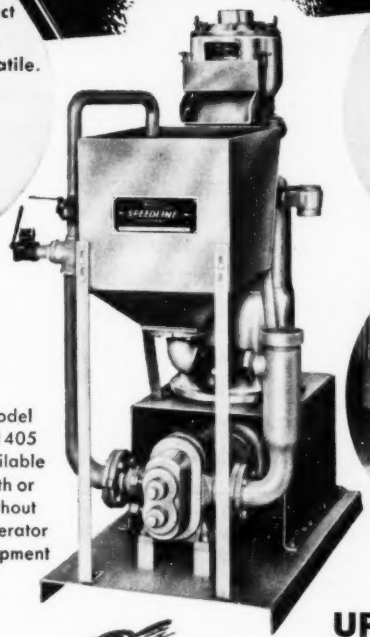


20"x 51" —compact and versatile.

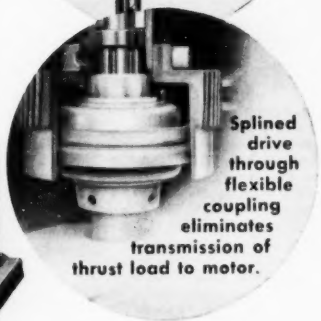


Double-bearing spindle assembly assures positive radial align-ment.

Lightweight head is easy to remove.

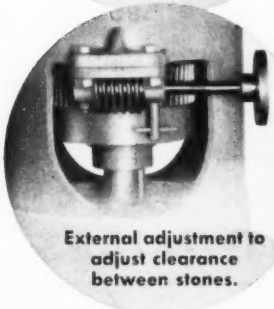


Model B-1405 available with or without deaerator equipment



Splined drive through flexible coupling eliminates transmission of thrust load to motor.

Polished processing chamber is easy to clean.



External adjustment to adjust clearance between stones.

More production in a fraction of the space at a fraction of the cost.

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In addition, the Morehouse principle of high-speed grinding and the accuracy of adjustment possible combine to produce end products of highest quality, superior in appearance and texture. It is available with or without deaerator, for elimination of entrained air if necessary.

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The INSTITUTE Spokesman

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ABOUT THE COVER

The cover shows the latest addition to Morehouse Industries' SPEEDLINE milling and deaerating equipment for the grease and lubricant industry. This latest model—B-2005 with Deaerator—is mounted on a movable base, 40 inches by 60 inches. The mill, operating at 5400 RPM is powered by a 40 horsepower motor, and the deaerator by a 20 horsepower motor. The same control of the degree of milling is obtainable in this latest model as in the earlier B-1405 mill and deaerator unit. Control to a fraction of 1/1000 of an inch between the milling planes is possible.

Milling and deaerating rates as high as 25,000 pounds per hour have been reported, and deaerating rates as high as 1,000 pounds of grease per minute have been observed. Rates of milling and deaerating will be dependent upon the type of grease being handled and the degree of milling necessary in the finished product.

LUBRICATE FOR SAFETY - EVERY 1,000 MILES -

President's page

by Howard Cooper, President, N.L.G.I.

JOINT RESPONSIBILITY

Contrary to an all too widely held belief, good lubrication depends on more than just the lubricant involved. Lubricants of finest quality can be utter failures in service, if they are not properly applied. The lubricant manufacturer is often the victim of unjust condemnation for mechanical failures, when the real responsibility may lie with the method of application or at the door of the operator of the machinery.

It is a time worn aphorism that the optimum in lubrication depends on "the right lubricant, in the right place, in the right amount, at the right time". From this it is apparent that the lubricant per se is but one factor in attaining the best in lubrication performance.

Given an understanding of the mechanical and operating requirements, and having a knowledge of the character and capabilities of lubricants, based on research and practical experience, a lubricant manufacturer can produce a product to render good lubrication performance. However this cannot be accomplished unless proper attention is given to methods and frequency of application. Thus it is highly important that the designer and builder, and also the operator of the equipment keep well in mind the problem of lubrication, on which the successful operation of the mechanism may well depend.

Accepting the premise that a correct lubricant is or will be available, provision must be made for its application "in the right amount and at the right time". Practical aspects, such as convenience to the operator should not be overlooked, so that there cannot be the alibi that failure to apply lubricant was due to inaccessibility. The operator, too, has responsibility in seeing that proper application procedures and schedules are followed.

Through understanding of the requirements and execution of respective responsibilities, effective, efficient and economical lubrication, and the successful performance of equipment can be attained. At the same time, in cases of mechanical failures or lubrication deficiencies, it is unfair to point an accusing finger at any one factor until all others have been studied and appraised.

Multi-Purpose Grease -

PROFITS PLUS

Under this general topic I have segregated our findings into two divisions.

I Service Stations

II Commercial Accounts

SERVICE STATIONS

In the initial sales attack on this type of operation the matter of price, which we had feared most, did not offer any serious resistance. The real bug-a-boo to be overcome was the deep rooted acceptance on the part of both company representatives and station operators of the principle of "A Special Product for Every Application". Throughout the historical past marketers have insisted that for correct lubrication, special grease was necessary for each specific job. This, even to the extent of taking pride in the number of different greases in their warehouses. Undoubtedly in the past, materials and techniques justified such a position, which imposed hardships on lubrication service through increased inventories, wastage and possibilities for misapplication. These individuals seemed to think we were coming to them with a compromise of several greases, or offering a "Bear-Grease" "Cure-All" technique. With this background of skepticism confronting us we proceeded in the introduction of Multi-Purpose grease by educational methods to point out the specific characteristics of the grease which made it possible to do a better lubrication job at each unit or part for which the grease is recommended. Emphasis was placed on Multi-Purpose rather than "All-Purpose."

After this general approach to those selling and those purchasing we paraded the characteristics of Multi-Purpose grease as handed to us by the makers, chemists, and testers. The following phrases were used to engender interest necessary in order to get initial orders.

One Gun — One Product
Less Investment — Less Inventory
You Can't Use The Wrong Grease
No Waste
Cleaner Stations
Cleaner Customer Garages
Customer's Satisfaction

From this trial package beginning, repeat business and additional requests grew. This was especially true from stations with reasonably good facilities in lubritoriums. In the grease-monkey type of operation, the use of Multi-Purpose grease is still in the infancy state. However, at this time we have reached a position where facts in relation to the human acceptance and economic operation will back up the intangibles and the initial sales arguments of yesterday. Chassis jobs have been shown to last up to 50% longer. Wheel bearings can be serviced less frequently. Personnel is pleased by the elimination of petty annoyances such as selection of gun, empty gun, and misplaced equipment.

Cleaner Stations are a Fact.
Economies Have Been Demonstrated.

To illustrate this latter declaration on economy, I have chosen a station which has shown very good results, for two reasons:

1. To stress the point of greater profit.
2. The Station had records in more detail than most.

Also, it was predominantly a neighborhood type of business with only about 10% transient trade. The data obtained reflects the trends and results shown by many other stations operated in different localities by several different suppliers.

In the tabulation set forth below the 1948 period represents the use of four greases for various applications, whereas in the 1949 period only Multi-Purpose Grease was used.

Service Station — 3 Bays — 2 Racks

	1948	1949	%
Total Grease Jobs	3462	4815	+ 39%
Total Wheels Serviced	710	834	+ 17%
Total Spring Packs	950	1,096	+ 14%
Total Grease (lbs.)	6,000	4,600	— 23%
Labor—Man Hours	2,600	2,300	—11.5%
Labor Cost	$ 2,080.00	$ 2,300.00	+10.5%
Product Cost	960.00	874.00	— 9.0%
Product Cost per Job	.28	.18	— 35%
Total Cost	3,040.00	3,174.00	+ 4.0%
Cost per Job	.88	.66	— 25%
Revenue	5,750.00	8,187.50	+42.5%
Gross Profit	2,710.50	5,013.50	+ 85%

COMMERCIAL ACCOUNTS

The approach to initial sales in this field was easier than in the case of Service Stations since most maintenance personnel had information taken from technical papers or trade publications, and were somewhat familiar with the properties and performance possibilities of Multi-Purpose greases. This understanding of characteristics, laboratory tests and applica-

SIMPLIFICATION

by A. C. SOMMERS

Richfield Oil Corp. of N. Y.

tions established a firmer foundation for discussion. However, we found this same maintenance personnel to be more prone to consider cost per pound, rather than the predicted over-all estimate of savings, which in the beginning could be offered only as a prediction unsupported by facts taken from service experience. Unlike the station operator the superintendent of a fleet must show savings in cost per ton mile, cost per passenger mile or volume of product consumed. The trial period on selected equipment, therefore, usually proceeds for six months to a year. However, when convinced and backed with even slight economies, these accounts are enthusiastic boosters for Multi-Purpose grease.

In order to illustrate the possibilities in savings, a bus transportation operation has been selected. In these tabulations actual savings by their book figures are not outstanding. This is partly due to the inability to break down labor costs, since the grease job was done partly by the same personnel doing mechanical repairs. In a few tests on individual time studies, there were time savings from 6 to 10 minutes per job. These studies were taken on complete grease service, including wheel bearings, with elapsed time averaging forty minutes. In the 1948-1949 period six greases were used, furnished by three suppliers; in the 1949-1950 period Multi-Purpose grease was used exclusively.

BUS LINE OPERATION

128 Vehicles in Urban and Interurban Service

	1948-1949	1949-1950	%
Bus Miles per Year	9,531,600	10,444,800	+9.5%
Grease Jobs—Chassis	4,130	4,180	+1.2%
Wheel Bearing Service	406	232	—42%
Grease Consumed (lbs.)	8,475	6,300	—25%
Grease Consumed per 100,000 Miles (lbs.)	90	60	—33%
Cost of Product	$ 1,313.65	$ 1,197.00	—8.8%
Steering, Springs, Shackles	6,138.60	4,909.20	—20%
Wheel Bearings Replaced	74	17	—77%

Just how much of the wheel bearing replacements and chassis maintenance can be attributed to the new product is not specific since factors other than grease must be considered.

Among advantages of Multi-Purpose grease of interest to all operators, but more specifically to out-door, non-permanently located operations, such as road building and other contracting jobs, is the reduced number of containers required. Mobile equipment can often be serviced on the job with one gun and with one grease; when several lubricants are required it may be impractical to carry a supply of different products and several grease guns for lubrication, so that for proper lubrication equipment may have to be returned to a shop or service center. It is obvious that where this is done there is likelihood of inattention to the frequency of lubrication important to the best protection and maintenance. Operators are reluctant to take equipment away from productive work.

Two cases from among contractors are cited for illustration.

Contractor "A" — Road Building

	1948	1949	%
Equipment	83 Units	86 Units	+ 3½%
Grease Purchased	14,280 lbs.	11,500 lbs.	— 19%
Labor	3 Men	2 Men	—33½%

Contractor "B" — Home Building

	1947	1948	%
Equipment	By subcontract	Same	
Homes Built	4,630	6,906	+49%
Grease Purchased	48,000 lbs.	36,000 lbs.	—25%

Contractor "B," one of the largest home builders in the world, sub-contracted his equipment requirements, but supplied these contractors with materials including fuels, and lubricants. The large savings in grease purchases were found to be in the elimination of loss and waste. When equipment was moved the operators neglected to take with them the many containers that had been partially consumed. With the use of Multi-Purpose grease fewer containers were on the job to be left behind in moving. Also, the hazard of contamination by dust, sand and water was substantially lessened.

Among diversified types of operations several suppliers report customer satisfaction by voluntary remarks such as:

Better results than any grease used before.
Now used throughout entire plant.
Well pleased for use as chassis and wheel bearing grease.
Now using for all pressure fittings.
25% savings in quantity used.
Customers notice the difference.
Stays in service 3 times longer.
Replaces 4 greases.
Better in sub-freezing temperatures.

Since we distribute products solely through franchised distributors our contacts with stations and consumers have been more or less as a second party. However, we do give merchandising and engineering assistance to them and maintain field personnel for this service. In view of this type of operation the response from distributors for the Multi-Purpose grease has been particularly encouraging. Anything that decreases inventory is welcome since it eases their burden in warehouse space, investment, credit and distribution.

Many distributors are dependent upon tank trucks or pick-ups for package delivery. Also, some are one or two-man operations. This decrease in products and packages has made them more efficient in serving customers, since it is easier to maintain inventories by grades and packages. By and large, distributors have readily put in effect the desire to simplify their grease sales and service. In some instances less profit may have been taken in meeting competitive or customer conditions by supplying Multi-Purpose grease in place of

previously used products. However, the dollar or cents value involved has been negligible.

Perhaps you find we have been overly enthusiastic and optimistic in both approach and acceptance of Multi-Purpose grease. However, I do not desire to leave the impression that some obstacles were not experienced. There were instances of misapplication, such as cases of worn wheel bearing retainers which called for grease of a harder consistency. Also, some service personnel still believe that "the more grease, the better job of greasing."

After consideration of our own problems and discussion with distributors we have concluded that Multi-Purpose grease makes possible simplification in marketing and servicing. Since we market only to distributors who serve automotive outlets and operations it has already been found possible to drop cup grease and water pump lubricant from our schedule; also the conventional type, or specialized chassis grease is no longer furnished in some size of containers that were once available. In our marketing operations the increasing acceptance of Multi-Purpose grease has displaced the previous individualized greases for chassis wheel bearings, water pumps, springs, etc. to a point where currently our sales of Multi-Purpose grease represent approximately 55% of our total grease sales. Perhaps we may be unable to convert entirely to a single grease; but such simplification is not entirely out of reach in our type of operation. Such simplification would affect the container aspect, contributing to an easing of the always annoying package inventory by grades and brands.

Emphasis is made that the examples shown and decisions made in supporting the Economics and Human reactions to Multi-Purpose grease in Automotive Lubrication were taken with distribution of one grade which was N. L. G. I. No. 2. With the actual elimination of other greases in this lubrication service it may be found that other consistencies may have to be provided to take care of worn retainers, track rollers and some other special applications or conditions in the automotive field.

As mentioned before, Multi-Purpose grease, by its characteristics, provides opportunity for discussion of its uses and benefits. However, of equal importance is the ease that on-the-spot visual demonstrations can be made. Along this line some companies have assembled equipment showing this product's properties in a dramatic fashion. The demonstrations combine near accurate test methods with simplicity and sales appeal; comparisons which the eye can grasp can be made quickly.

The only summary that can be made of what has been said here is to state, that the chemical and physical properties of Multi-Purpose grease were accepted as given by the technicians. With these facts, we went out and tried to make it work under our conditions of marketing and customer service. We think it has done a better job.

In conclusion, and apart from the subject of Multi-Purpose grease, I suggest that influence be used on your respective companies for emphasis on grease recognition. Many executives overlook the fact the 60% of Motor Oil Sales at Service Stations are made at time of chassis lubrication. I wish to express appreciation to those of your members who have aided me by their experiences and ideas.

Discussion of

Multi-Purpose Grease — PROFITS PLUS SIMPLIFICATION

by H. L. HEMMINGWAY
The Pure Oil Company

Mr. Sommers has ably discussed a difficult problem and we agree with the wisdom of his decision to discuss the growing popularity of multi-purpose greases not only in terms of cold figures but also in terms of "human reaction" or the intangible appeal of this type of product to the buyer. While we are not large marketers of multi-purpose greases, we have rather carefully studied the economics of using multi-purpose greases in service station, fleet, and industrial applications.

Before discussing our own findings, however, there are a few points in Mr. Sommers paper on which we have comment. First, we believe that in the table showing the statistics on the service station operation, it would have been preferable to have separated the wheel bearing and spring pack jobs from the chassis grease jobs, as far as quantity of grease used per job and time per job are concerned. With all respect to multi-purpose greases, we do not believe that their use results in any substantial saving of grease—or time—on spring pack or wheel bearing jobs. Therefore, if we subtract the probable amount of grease and time required for these jobs, then the amount of grease and time for each *chassis* grease job looks something like this:

	1948	1949
Total grease use per grease job	App. 1 Lb.	App. ½ Lb.
Time per grease job	32 min.	19 min.

While we are perfectly willing to concede that this reduction in grease consumption is due to the use of the multi-purpose grease, we also believe that the same — or even greater—reduction could have been obtained by an improvement in the quality of the original chassis grease used, regardless of its type. Secondly, our own tests do not show that it is possible by any stretch of the imagination to save 13 minutes per car by using one grease instead of four.

Furthermore, we believe it is not implied in the paper, nor should it be implied, that the increased number of chassis grease jobs in 1949 was due to the use of multi-purpose

grease. In fact, if this station was open 6 days a week, for 8 hours a day (a very conservative figure for a neighborhood service station) its two racks had a total available time of 4,992 hours. Yet the man-hours figure for the lubrication services mentioned, of 2,600 hours in 1948 and 2,300 in 1949, indicate a rack utilization factor of only about 50% or less—exclusive of time required for oil change and transmission and differential service.

Our own tests were conducted in 1949. Our Market Research department was assigned the job of determining what advantages there might be to using a single multi-purpose grease in place of the three we usually stock—a chassis lubricant, water pump lubricant, and combination wheel bearing and universal joint lubricant. (It should be pointed out here that for the normal 1,000 mile chassis lubrication job, on about 60% of the cars we recommend *only* the chassis lubricant for all grease fittings. The additional 40% of cars require the combination wheel-bearing and universal joint grease, while only 26% require water pump grease.)

Four stations were selected as follows:

Type Business	App. Monthly Gasoline Gallonage	Number of Lifts
Transient & Neighborhood	8,000	One
Neighborhood	30,000	Two
Transient & Neighborhood	30,000	One
Neighborhood	15,000	Two

The test period was 60 days. An experienced time study man armed with a notebook and stopwatch spent at least a week at each station timing the lubrication jobs. Before the test, the technical characteristics of the multi-purpose grease were explained to the operator but any attempt to "*sell*" was carefully avoided. The multi-purpose grease was sold to the operators at the same price as regular chassis grease during the test period in order that operator reaction could be determined exclusive of price considerations. The final report runs into some 27 pages and tables, but it can be summarized briefly:

1. There was no measurable time saving. The usual assumption that it might be possible to do more lubrication work using Multi-purpose Grease, based on the slight, theoretically possible time saving is erroneous. In the average service station, lubrication is not an assembly line job, but there are unavoidable time lapses between jobs, or resulting from the lubrication man being called away from his job, etc. These more than compensate for the slight, theoretically possible time saving.

2. There is some possible elimination of lubrication equipment. In the survey we made, this amounted to two hand guns per service station. The operators, however, were more impressed by not having to perform the messy job of filling hand guns than they were by the elimination of the equipment.

3. The absence of misapplication is real, and was important to the service station operators—most of whom have had unfortunate — and expensive — experiences with product misapplication.

4. The saving in storage and inventory space was found to be of some slight importance, especially in the service station.

Our survey indicated that the tangible advantages of using multi-purpose greases in service stations—economic or otherwise—were relatively unimpressive. The intangibles, however, or the "human reactions" which Mr. Sommers has stressed, have been impressive to us. As stated, no attempt was made to "sell" this grease to the operators. The nature of the test actually minimized the sales advantages which would usually be emphasized. After the test, we increased the price of the MP grease to its true selling cost—just about twice that of our regular chassis grease. Last month—one year after the test was concluded, we went back to the four stations and found this situation:

> Two operators had discontinued the use of the MP grease because of price. One had discontinued it reluctantly because of dispensing troubles at low temperature. When advised that a follower plate would probably solve his troubles, he indicated that he would switch back to MP. One was still buying it and was high in his praise of this type of grease.

These results were surprising to us in view of the relative lack of tangible advantages to the use of MP grease.

A survey was also made of the fleet and industrial field of application for MP greases. Our findings generally agree with those of Mr. Sommers, except that we found the fleet operators we interviewed more interested in performance, simplification of lubricant inventory, and the reduced possibility for mistakes than they were in the somewhat higher price.

Opinions expressed in this article are not necessarily the views of the NLGI.

THE STRUCTURE OF *Aluminum*

INTRODUCTION

A paper by Lawrence entitled "The Structure of Lubricating Greases,"[1] which appeared in the Journal of the Institute of Petroleum Technology about twelve years ago was apparently the first comprehensive treatment of the preparation and properties of greases to be based on the principals of colloid chemistry. It had already been appreciated that greases are colloidal systems,[2,3] but this classic paper offered the first integrated discussion of their development and final structure. Since that time an interest in the theory of grease structure has developed rapidly and an increasing number of papers have appeared on this subject during the past decade.[3-14,20,24,25,26] Novel experimental techniques[14,16,17,27] and new tools like the electron microscope[4,8-10,24] and X-ray diffraction apparatus[20,26] have been employed in elucidating the structure of lubricating greases. Furthermore, many observations have been made in the broader fields of colloid chemistry which are applicable to grease theory.

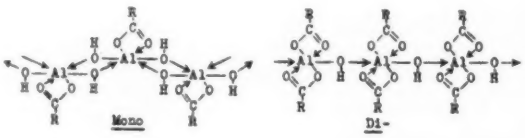
This paper comprises an attempt to bring together some of the ideas advanced to date and to use them in explaining the formation and properties of aluminum greases. This type has been selected because its preparation from a pre-formed soap simplifies consideration of the dispersion process.

THE STRUCTURE OF THE ALUMINUM SOAPS

The structure of the aluminum soaps themselves must be given consideration because it seems to be preserved or re-established in the grease-forming process.[22,26]

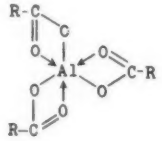
There is good reason to believe that the aluminum soaps are polymeric substances, more akin to rubber, polystryene or nitrocellulose than to compounds like aluminum sulfate.[15,16,27,28,33] Their lack of definite crystallinity, their susceptibility to plasticizers and their high viscosity above the softening point tend to confirm this view.[18,19,28,33] McGee[28] and Gray and Alexander[19] have offered a rather complete picture of the arrangement of molecules in these soaps, and it may be well to review their theories before proceeding to a discussion of the greases themselves.

In setting up their model of an aluminum soap unit, Gray and Alexander[19] have taken into consideration the fact that aluminum, having coordination numbers of four and six,[19,28] can attract other atoms than those to which it is attached by its normal valence bonds. The resulting coordinate linkages are strong enough to join separate molecules of aluminum soap together, thus forming large aggregates. They and others[15,28,29] have proposed structures for the mono- and di-soaps which may be represented as follows:[16]



In these diagrams, normal valences are indicated by the conventional straight-line bonds, coordinate linkages by arrows. These chains may be of considerable length, particularly when the soap is in the solid form. McGee,[28] in suggesting a similar structure, has shown how the chains may terminate in fatty acid or aluminum di-soap molecules and it may be assumed that other coordinating compounds may also act as terminators.[16] These chains of molecules are similar in general form to linear polymers,[16] but differ in that they can be broken up and recombined much more easily because they are not linked by the more stable carbon-to-carbon bonds.

If a tri-soap exists,[13,16,25,28,29] and there is no commonly-accepted evidence that it does, it might be expected to have a symmetrical structure:

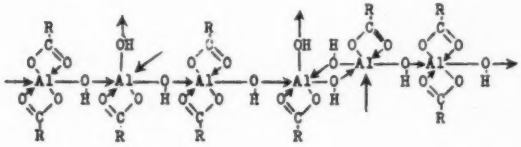


In addition to mono- and di-soaps it is possible to prepare seemingly homogeneous compounds of intermediate composition and many commercial soaps for grease-making are of

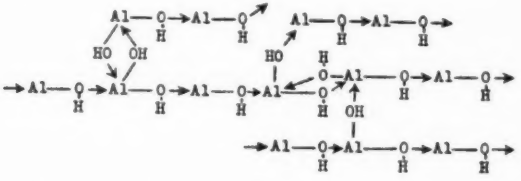
Greases

by W. K. DEAN
Mallinckrodt Chemical Works

this type. It is therefore possible that units of both the mono- and di-soaps may be present in the same chain, according to the following structure:

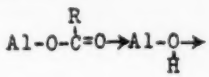


It will be noted that the mono-soap molecules in a chain of this type introduce a new condition. There are points (indicated by the dotted arrows) where new coordinate linkages can occur, and this suggests the possibility that branching and cross-linked chains can develop:

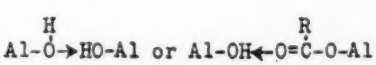


Furthermore, it is also possible to prepare seemingly homogeneous soaps containing more aluminum oxide than is required for the mono form. If chains of mixed units are also present in these products, aluminum hydroxide molecules may be shown to act as foci for three or four chains, and thus structures of great complexity can be built up. Since only the di-soap molecules are restricted to linear polymer formation by this mechanism it appears that the amount of branching would be approximately proportional to the number of mono-soap and aluminum hydroxide molecules present in the total composition. Linear hydrocarbon polymers are known to be more elastic than the corresponding two and three dimensional forms, and this may account for the relative elasticity of di-soap gels and the greater brittleness of those containing soaps with higher aluminum oxide content.

The possibility exists that polymerization or cross-linking may also occur through coordination between the aluminum atom and the carbonyl oxygen:[18,20,88]



or through hydrogen bonds:[88]



The development and stability of the aluminum soap chains can be augmented by the intermolecular or van der Waal's forces originating in the fatty acid radicals.[7,19,98] This will strengthen the polymer by drawing the hydrocarbon radicals together and may also cause adjacent polymer chains to adhere.

The commercial aluminum soaps may therefore be considered as polymeric substances formed from the mono- and di-compounds and possible some aluminum hydroxide and free fatty acid.[12,19,95] In the solid state the soap molecules are extensively polymerized in at least one dimension through coordinate bonds between aluminum atoms and hydroxyl groups. The fatty acid radicals radiating outward from these linear polymer chains are held in alignment by intermolecular forces which strengthen the chains. Other intermolecular forces exist between individual chains, uniting the entire system in a rigid structure.[99]

THE DISPERSION OF ALUMINUM SOAPS IN OILS

The aluminum soaps customarily used in grease-making will not disperse readily in even the lightest lubricating oils until the system is heated, and a rapid rate of dispersion is usually not observed until the temperature reaches 190-220° F. Gradual dispersion will occur at somewhat lower temperatures,[18,91] but at the heating rates normally employed in grease-making this effect is scarcely noticeable. Instead, the mixture of soap and oil retains its original appearance until the dispersion temperature is reached and it is suddenly converted to a thick, transparent gel.

This phenomenon is apparently a result of the weakening of those intermolecular forces which exist between the polymer chains.[18] The soap particles are simultaneously transformed from a solid to a plastic state as shown by the sudden weakening of their X-ray diffraction patterns.[17,20] The chains are then quickly separated by the influx of the oil and there is an immediate increase in the viscosity of system due to these polymer chains permeating the oil. Some cleavage of the chains may also occur which would tend to lessen the viscosity increase since short polymer chains contribute less to the viscosity of a system than long polymer chains do when equal weight amounts of each are in a solvent. In systems composed of aluminum dilaurate dispersions in benzone and cyclo-hexane there is an increase in viscosity for a short period as the temperature is raised above the dispersion point.[27,80] This is attributed to the unfolding of the polymer chains which were separated by the oil upon heating at the dispersion point.

When the aluminum soap has dispersed in the oil, it is possible to cool the mixture immediately and obtain a grease.

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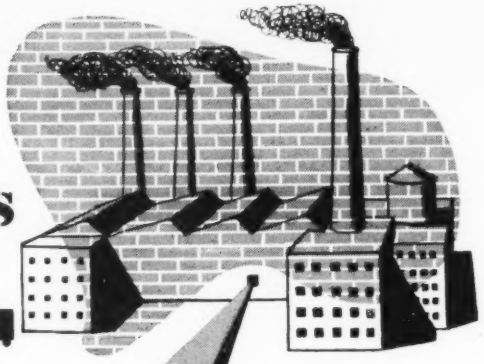

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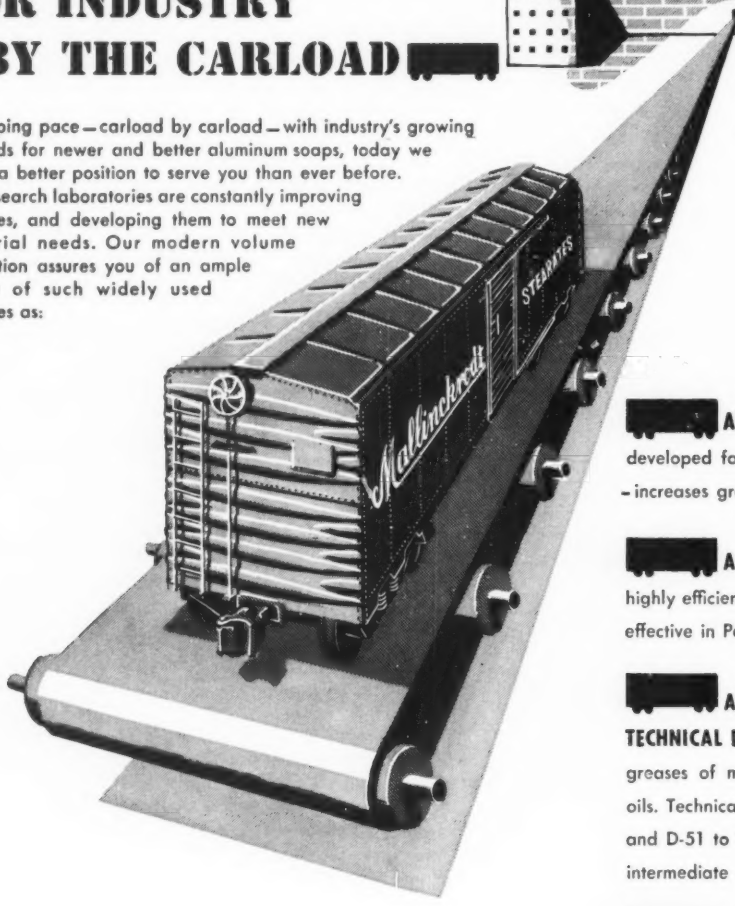

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However, general experience has indicated that greases which have not been heated above the dispersion temperature often show oil separation and an irregular structure after normal cooling. A possible explanation might be that the soap chains, although dispersed, have not as yet broken up into small units; and upon cooling, the gel contains particles which are too large and the soap phase is too discontinuous to produce a stable structure.

Further disruption of the soap polymer chains occurs during the heating period customarily given aluminum greases. As the energy content of the soap-oil system increases, the coordinate bonds which have connected the molecules begin to break and the polymer chains are separated into shorter and shorter units. As a result, the grease becomes more fluid. Thus, by the time the grease reaches the temperature range 260°-300° F. the soap is a quite homogeneous dispersion of short polymer chains or "crystaloids" and perhaps some individual molecules. These units are relatively mobile[30] and have lost most of their ability to thicken the oil.

DEVELOPMENT OF THE SOAP STRUCTURE DURING COOLING

The cooling of a grease causes transformations in the soap structure which are essentially the reverse of those occurring during the heating stage.[18-21] As the temperature of the system falls, its internal energy is reduced; allowing the coordinate bonds and intermolecular forces between the particles to re-establish themselves. The viscosity of the system increases steadily as the new soap structure develops, and the end-result is the fully thickened grease.

Lawrence[18-21] has made a rather extensive study of these transformations and states that most soap gels show two transition temperatures. The first T_1, is the point at which the highly-dispersed soap particles begin to coalesce to form an elastic gel structure, and at the second, T_2, this elastic gel changes to a rigid modification due to the separation of the soap from the oil in an essentially solid form. The strength of the grease is proportional to the difference between its temperature and T_1, as long as this temperature is above T_2. After the soap begins to separate from the oil at T_2, further cooling produces no proportionate increase in body.

This concept of soap separation may be traced to earlier papers on soap gel systems.[7,22] Lloyd[22] has pointed out that virtually all gels are two-phase systems in which the gelling agent is a distinct physical entity of sufficiently large particle size to permit its separation from the liquid phase by ultrafiltration or dialysis. She further states that the existence of a gel is *prima facie* evidence of the insolubility of the gelling agent in the substance gelled. A grease may therefore be considered as a mixture of a relatively insoluble body (the soap) in a fluid medium (the oil), and at all temperatures and concentrations at which thickening is observed at least a portion of the soap is present as a separate phase, unless in the case of aluminum soap oil systems the polymeric type of molecule formed by the aluminum soap molecules is to be considered in solution in the sense that polymer molecules are considered to be dissolved. In this instance there would be a viscosity increase without the soap constituting a separate phase. However, a true molecular dispersion of the aluminum soap molecules similar to the dispersion occurring when sugar is dissolved in water could not be considered if the viscosity of the system is substantially above that of the oil alone. In cases where the soap is present as a separate phase the soap particles may be extremely small and the system essentially homogeneous without constituting a solution. Thus, when Lawrence speaks of the separation of the soap below T_2 he does not refer to a process exactly like the separation of crystals from a supersaturated solution. The soap is already present as a separate phase at higher temperatures but the soap particles are so small and are so intimately combined with the oil that an apparently homogeneous system exists.

At T_2 this disperse soap phase seems to coalesce and "shed" the oil. The affinity hitherto existing between the oil and soap is greatly reduced and it becomes possible to withdraw individual soap fibers from the grease.[14,21] At temperatures below T_2 the soap may withdraw from the oil almost completely and settle out as a pulpy, semi-crystalline mass. The temperatures at which these transformations occur are dependent upon the forces of attraction between the soap molecules. Highly polar soaps like sodium, calcium or barium stearate which are difficult to disperse will lose their affinity for the oil at a relatively high temperature, while greases made from soaps containing metals like cobalt, nickel or iron must often be cooled below room temperature to reach the T_2 stage.[18,19,21]

The aluminum soaps may be considered as intermediate types; rather easy to disperse and undergoing the T_1 and T_2 transformations at moderate temperatures. Using Lawrence's ideas and the concept of polymer formation in the aluminum soaps, the following explanation of the changes in structure occurring during the cooling of an aluminum grease may be derived:

It can be assumed that the soap polymer chains are extensively dissociated by the oil at temperatures above, say, 260° F. and that the resulting soap particles are mobile and free to arrange themselves in any way.[26,30] As the temperature of the system is lowered, the coordinate bonds between the aluminum atoms and adjacent hydroxyl groups can be re-established and new polymer chains will begin to grow. These can extend in all directions, forming a network throughout the oil and producing a state of gelation.

Further cooling increases the firmness of the gel. The aluminum soap chains continue to grow in length and cross-links may develop. Throughout this stage the soap is "insoluble" in the oil and apparently constitutes a separate phase; although it has a very fine, filamentous, elastic structure. Intermolecular attraction between the oil and the fatty acid radicals of the soap probably still exceeds that between the soap chains, causing the two phases to have a considerable affinity for each other.[26] It is during this period that a true gel structure (or jelly)[26,34] may be considered to exist.

This is the critical period in the development of the grease. It is well-known that when aluminum greases are cooled rapidly, a brittle gel often results while slow cooling may fail to produce the proper "set" and the grease remains in a semi-fluid condition. Experience has shown that particular care must therefore be exercised, especially during the middle part of the cooling period.

When the system is cooled rapidly during the development of the soap polymer chains, the extent of their growth will be arrested and the final grease will contain a tremendous number of extremely fine filaments.[33,34] Unless these are

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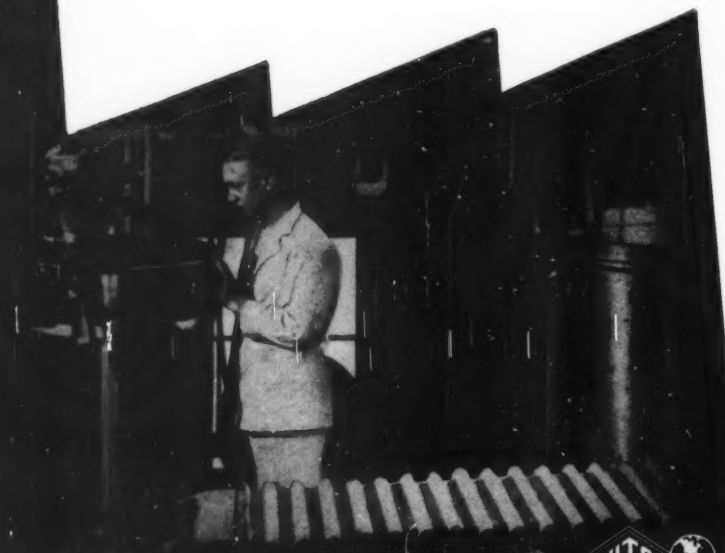

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exceedingly small, they will be capable of holding the oil quite firmly through their capillary action.[4] A gel-structure of considerable strength can therefore result even though the soap concentration may be relatively low. On the other hand, if the soap cools slowly, it remains in a semi-fluid state for a longer period of time, giving the soap fibers more opportunity to grow. The natural movements of the molecules in the system may also bring short polymer chains together, allowing more linkage to occur and providing an opportunity for the chains to group themselves into fibers. If a relatively low percentage of soap has been used, the larger filaments or fibers formed in this way may not be numerous enough to produce a firm gel and the grease will remain in a semi-fluid state.

This line of reasoning finds some substantiation in Lawrence's observation that a weak aluminum grease resulting from slow cooling can be saved by reheating it and cooling more rapidly.[21]

The behavior of aluminum soaps during this stage finds a parallel in crystallization phenomena. When a hot, saturated salt solution is chilled, many tiny crystals are formed; while the same solution under conditions of slow cooling, will deposit fewer but much larger crystals. Proper adjustment of the cooling rate will produce crystals of almost any desired size. In the same way, intelligent control of temperatures in the cooling room, will produce lubricants having good body and texture.

By the time the cooling process nears completion, the energy content of the soap-oil system has been greatly decreased. This allows even the weaker intermolecular forces to become effective again. The hydrocarbon chains in the fatty acid radicals are drawn toward each other and adjacent polymer chains are mutually attracted. If the forces of attraction between the soap molecules and chains become stronger than those between the soap and the oil, a number of polymer chains may align themselves along a common axis and coalesce to form a soap fiber of appreciable size.

Adherence between the fibers can develop at points of close proximity as a result of the forces of attraction existing between them. This will impart some rigidness to the soap structure. Aluminum soaps appear to retain sufficient affinity for most lubricating oils to prevent the formation of fibers more than a few microns in length,[11] and extensive separation from the oil is seldom observed. Lawrence's T_2 point for aluminum greases, therefore, appears to be relatively low; perhaps around 100° F. In light petroleum fractions of low solvency value, however, the soap frequently separates almost completely after the dispersion is cooled showing the dependency of T_2 on the nature of the dispersion medium. Sodium, lithium, barium and hydrated calcium greases generally show a much more distinct fiber structure,[2,4-6,8-11,14] probably because of the stronger mutual attraction of the metal-containing groups in the soaps.

The final soap structure in a properly cooled aluminum grease is the end result of the repolymerization and coalescence of the dissociated particles which were formed during the dispersion and heat-treating steps. During the greater portion of the cooling period, the grease is in much the same state that prevailed after the dispersion of the soap. A truly gelatinous condition exists wherein the soap filaments are extremely numerous and of colloidal or subcolloidal dimensions. When these filaments have grown to appreciable size later in the cooling period, they form a non-gelatinous, interlocked network of fibers throughout the grease. The continuous phase is considered to be a "jelly" consisting of finely dispersed aluminum soap in the oil.[26] If these ideas of the structure of an aluminum grease are substantially correct, its final form may be quite similar to that of a sponge filled with gelatin "solution."

OPTIMUM SIZE OF SOAP PARTICLES

At some time during the growth of the soap filaments it is possible that they could simultaneously attain a size which is ideally suited to the entrapment of oil. This would be a counter part of Alexander's "zone of maximum colloidality"[1] wherein particles exhibit their colloidal properties to a maximum degree. If such a soap particle size could be discovered and cooling methods developed which would stabilize most of the soap in this condition, a remarkable improvement in grease properties might well result.

THE PHYSICAL PROPERTIES OF THE ALUMINUM GREASES AS RELATED TO THEIR GEL STRUCTURE

The properties of aluminum greases can be explained by recourse to the theories on the structure of aluminum soaps and the formation of aluminum greases which have been described.[6,8,10,18,20,33]

CLARITY

The lack of turbidity common to aluminum greases appears to be due to the extreme fineness of the soap filaments. Particles smaller than the wave length of visible light are not capable of producing strong optical effects, and, as noted by Farrington and others,[9,11] the aluminum greases seem to contain a large percentage of soap fibers in this size range. A corresponding condition probably exists in the clear calcium greases. The similarity between the refractive indices of the oil and soap can also contribute to the invisibility of the soap particles.

SYNERESIS AND BLEED

The terms "syneresis" and "bleed" are considered to designate two distinct mechanisms by which oil may separate from a grease.[4] Syneresis refers to the forcing out of oil through contraction of the gel structure, while bleed is the leakage of oil from a grease which contains an inadequate gel structure. This inadequacy may be due to a low percentage of soap or to overly-large fibers.

Since low percentages of soap are used in the preparation of aluminum greases, one might expect that bleed, rather than syneresis, would be the principal cause of oil separation. This may be true, especially when the grease is slow-cooled and the total number of soap filaments has been reduced through coalescence and fiber growth. However, syneresis has been frequently observed in samples of greases made from low-viscosity oils and cooled rather rapidly. In some cases, the contraction of the gel is great enough to cause cracking and complete separation of the grease from the walls of the container.

One is therefore led to the conclusion that very appreciable forces are acting to draw the soap filaments or fibers together. These are probably the intermolecular or van der Waal's forces which have been shown to exist between the soap filaments. Since the soap structure in a rapidly-cooled aluminum grease is very tenuous, innumerable points of con-

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tact can exist between the filaments. The forces of attraction are thereby given ample opportunity to draw the filaments even more closely together and to collapse the capillary spaces between them.[35]

BEHAVIOR ON WORKING

Aluminum greases generally show a sharp decrease in body when first subjected to mechanical working. This indicates that the freshly-cooled grease possesses a fragile, "false" structure which is broken as soon as the grease is disturbed. This "false body" may be attributed to the random arrangement of the soap filaments and the forces of attraction between them. The tangled mass of filaments resists deformation up to the yield point, whereupon the forces of attraction are overcome and flow is initiated.[2] The soap filaments are then oriented along the streamlines just as the logs proceed down-river in an orderly way after a log-jam has been broken.

The twisting and disruption of the soap fibers themselves probably account for the gradual loss of grease consistency during prolonged working. Electron micrographs give conclusive evidence that sodium and calcium stearate fibers are affected in this way,[4,8,10] and it can be inferred that the aluminum soap filaments undergo a similar transformation. Further weakening of the intermolecular forces may also be a factor.

REBODYING

The rebodying often observed in aluminum greases is probably due to the re-establishment of some of the bonds between the soap filaments. This would allow the mixture of soap and oil to regain at least a portion of its original thickness. The elasticity attributed to the soap filaments may cause them to resume a random arrangement after the grease comes to rest, and thus could contribute to rebodying.[2]

This rebodying of aluminum greases can occur at an amazing rate under certain conditions. Samples which have been worked one thousand strokes and then penetrated immediately sometimes give erratic results for this reason. Our tests have shown that when such a grease is inverted in the cup, leveled and penetrated at once, the reading may be ten to thirty points higher than when a period of five minutes separates the leveling and penetrating operations. Furthermore, this waiting period is necessary after each inversion of the grease if consistent results are to be obtained. This behavior is much less pronounced after sixty strokes. The oil used in making the grease appears to have more effect on the rate of rebodying than has the soap or its concentration. It has not as yet been possible to correlate this rapid rebodying with the properties of the oil, but it should be taken into consideration in setting up standard procedures for determining worked penetrations after more than sixty strokes.

DROPPING POINTS

The fact that the aluminum soaps disperse easily and produce a tenuous structure probably accounts in large part for the low dropping points exhibited by their greases. The dropping point test determines the temperature at which the soap fails to hold the system in a non-fluid state under prescribed conditions. We have noted that during the initial stage of dispersion of aluminum soaps the energy supplied to the system in the form of heat disrupts the bonds between the soap chains and the soap phase is changed to a plastic state. It may be assumed that a similar dissolution of the soap structure in the grease occurs at the dropping point, and that the soap fibers are dissociated. It is therefore probable that the dropping points of aluminum greases are dependent on all the factors which affect the nature of the bonds within the soap fibers and their ease of disruption. Thus, the transition in the grease occurring at the dropping point is not solely related to the melting point of the soap. For example, it is commonly observed that the dropping points of aluminum greases are greatly influenced by the oils from which they are made.

Nevertheless, it is apparent that the melting points of certain metallic soaps or the temperatures at which they disperse during grease preparation are related to the dropping points of their greases. Sodium, lithium and barium soaps are characterized by high melting points[17] and high dispersion temperatures in most oils, and this property is reflected in the high dropping points of their greases.

THE EFFECTS OF OTHER GREASE COMPONENTS ON GEL STRUCTURE

The comments on the structure and properties of the aluminum greases which have been made so far were based on the premise that no substances other than the soap and oil are present and that the oil is an essentially indifferent body. These conditions are seldom encountered in practice and some discussion of the effects arising from the presence of other normal components should be included in any commentary on grease structure.

The modification of soap gels by "foreign" substances is very frequently observed and has received some investigation.[12,14,16,24] Though our knowledge of the subject is far from complete, a few important generalizations may be drawn from the information at hand:

1. Mineral acids and alkalies, amines and ammonia can completely decompose the gel structure.
2. Fatty acids, glycerides and glycerin soften the gel structure and often reduce the temperature at which the soap disperses.
3. Small amounts of water can increase the gelling power of certain soaps, but larger quantities produce a weakening action.
4. The smoothness and stability of aluminum greases is determined in part by the viscosity index and degree of refinement of the oil.

If the ideas on aluminum grease structure already presented are valid, they should form a useful basis for explaining these generalities.

MINERAL ACIDS AND ALKALIES

Strong acids and alkalies can destroy the soap molecules by chemical reaction, and this is probably the primary reason for their gel-breaking effect. This constitutes a special case not usually encountered in grease manufacture.

AMMONIA AND THE AMINES

Compounds containing a basic nitrogen atom are quite effective in weakening or destroying aluminum soap gels. It is interesting to note that, in this class, the most powerful gel breakers are ammonia, the short-chain aliphatic amines and pyridine;[16] substances which are known to coordinate strongly via electron donation. Since it has been suggested that the aluminum soap chains in a grease are built up through coordinate linkages between the electron-accepting aluminum atoms and electron-donating hydroxyl groups on neighboring

molecules, their reaction to the presence of other electron-donating substances constitutes an important test of the theory. A substance which could form a strong coordinate bond with the aluminum atom than can the hydroxyl group in an aluminum soap chain would be expected to split the soap polymer into small units and thus destroy any structure based upon the polymer chains.[15,16,28,29] This is apparently what occurs when ammonia or amines are added to aluminum soap gels. The soap is peptized by their splitting action, and the network of soap filaments or fibers is dissociated and returns to much the same state that existed at high temperatures.

FATTY ACIDS, GLYCERIDES AND GLYCERIN

The fact that fatty acids and glycerides can soften greases and promote the dispersion of soaps may be a result of two different effects: (1) disruption of soap polymers or modification of the soap polymer growth[8,15,34] and (2) a "bridging action" between the oil and soap.[12,18,21]

Disruption of the polymers or interference with their growth can proceed by a mechanism similar to that proposed for the action of amines since fatty acids and glycerides contain carbonyl groups capable of coordination by electron donation with the aluminum atoms in soap polymer chains or in soap molecules.

These compounds also contain hydrocarbon groups which have an affinity for the oil. The complex substance resulting from the combination of a metallic soap and a glyceride, for example, would therefore be expected to have a greater affinity for the oil than would the soap itself.[12,14]

The coordinating capacity of the hydroxyl groups present in glycerin may be assumed to account for the results obtained when this substance is present in greases.

WATER

When water functions as a gel-breaker in aluminum greases, its action can probably be ascribed to the ability of its hydroxyl group to coordinate with the aluminum atom.[15,16,29] This coordinating ability is apparently strong enough to split the polymer chains of at least some aluminum soaps, since aluminum oleate and naphthenate gels in light petroleum fractions can be completely destroyed at room temperature by the addition of small amounts of water. Partial hydrolysis of the soap may also occur.[13,21]

THE INFLUENCE OF THE OIL

The aluminum soaps seem to be particularly sensitive to the properties of the oils in which they are used.[21] In general, the paraffinic oils yield stiffer and more brittle greases than the naphthenic or asphaltic types, and the smoothness of aluminum greases generally increases with the viscosity of the oils within a given type. However, so many exceptions to the latter rule appear to exist that viscosity alone cannot be used to predict the performance of a given oil. Its viscosity index and degree of refinement appear to be more reliable criteria; for, as has been noted, polar or electrically unsymmetrical molecules can influence the development of the aluminum soap structure through their effects upon the growth of the filaments and the strength of the intermolecular forces existing between them.[12]

This is especially true of certain common, polar constituents of oil, such as nitrogen and sulfur-containing compounds and carboxylic acids, which are capable of coordination through electron donation. These polar constituents may arrest the growth and aggregation of polymer chains before they become large enough to have an effective gelling action.

The more polar oils should therefore yield weaker and smoother greases than do the highly-refined grades.[21] This is found to be true in the majority of cases. Oils of low viscosity index are usually much easier to use with aluminum soaps than those which are especially refined to raise this value to a high level. It also seems generally true that the pale, transparent oils produce aluminum greases showing more grain and syneresis than those obtained from the darker oils. Excessive refinement seems to remove those "impurities" which favor the formation of smooth stable greases.

The presence of aromatic or asphaltic substances in the oil may also influence the formation and properties of aluminum greases. The aluminum soaps do not separate readily from their dispersions in compounds like toluene and xylene. The relative ease with which aromatic substances are polarized may account for the enhanced affinity they display for these soaps. The smooth, relatively weak greases often obtained with the asphaltic oils reflect this capacity of polarizable substances to limit the development of an extensive, interlocked soap structure.

Consideration should also be given to the influence of constituents in the oil which apparently are not capable of as strong an interaction with the soap. There is experimental evidence[20] to show that a soap like aluminum dilaurate will separate from a paraffinic compound like n-heptane more easily than from an alicylic hydrocarbon such as cyclohexane. Evidently, the cyclic structure has a greater affinity for the aluminum soaps than does the straight-chain configuration.

This might explain the rather common observation that paraffinic oils often form stiffer and more brittle greases than do those higher in naphthenics. It may be that the paraffinic oils become "super-saturated" early in the cooling period and allow the soap to separate rapidly, forming a micro-structure which very effectively entraps the oil. Naphthenic oils, having a greater affinity for aluminum soaps, do not "supersaturate" as readily and give the soap filaments more opportunity to grow in length and diameter. As a result, fewer and larger filaments are formed and the final grease is proportionately weaker and less brittle.

All other factors being equal, the viscosity of the oil would also be expected to influence grease formation to some extent. An oil of high viscosity would impose some limitation on the movements of the soap particles and so reduce their ability to coalesce and align themselves in fibrous form. The final structure might therefore contain a preponderance of filaments having a relatively low length-to-diameter ratio, and this condition has been shown to reduce the consistency of greases.[4] The low viscosity oils would allow the soap units more freedom to migrate and form an extensive structure, thus producing a stiffer grease. Our observations substantiate this theory.

SUMMARY

It has been shown that modern ideas on soap gel structure can be used to explain the formation and properties of the aluminum greases. The aluminum soaps may be considered as polymeric substances in which the individual molecules are linked through coordinate bonds between hydroxyl groups and aluminum atoms. This linkage may be reinforced by van der Waal's forces between fatty acid radicals of adjacent soap

units. The soap chains may be associated by coordinate bonds, hydrogen bonds and van der Waal's forces.

When aluminum soaps are dispersed in hydrocarbons, their polymer structure is broken down until, at high temperatures, relatively few of the original coordinate and intermolecular bonds remain. In this state the soap forms a nearly homogeneous system with the oil and its thickening action is slight.

During the cooling of aluminum greases the soap units coalesce through re-establishment of the coordinate and intermolecular bonds. A polymeric structure again develops and the chains or filaments can aggregate to form fibers. The fibers may also adhere to each other at points of contact. This extensive network of soap filaments or fibers entraps the oil, giving the grease its final structure. The aluminum soaps probably have a sufficient affinity for most mineral oils to prevent their complete separation in fibrous form during cooling. Therefore, a small amount presumably remains in a highly dispersed state throughout the continuous phase. An analogy has been offered relating the structure of aluminum greases to that of a sponge filled with gelatin "solution." The sponge would represent the soap-fiber network while the gelatin "solution" suggests that the oil phase containing the remaining highly-dispersed soap may the thickened.

This concept of aluminum grease structure can also be used in explaining the properties of the aluminum greases and their response to the presence of "foreign" substances. Such diverse characteristics as the differences in consistency resulting from slow and fast cooling, susceptibility to the gel-breaking effects of water and other polar substances and properties of greases made from different types of oil can be shown to depend upon this tenuous soap structure and the nature of the forces holding it together. It is also suggested that these ideas can be applied, at least in part, to the explanation of the properties of other types of grease.

BIBLIOGRAPHY

1. Alexander, J., *J. Am. Chem. Soc., 43*, 434 (1921).
2. Arveson, M. H., *Ind. Eng. Chem., 24*, 71 (1932); 26, 628 (1934).
3. Birdsall, D. H. and Farrington, B. B., *J. Phys. Colloid Chem., 52*, 1415 (1948).
4. Bondi, A. A., Cravath, A. M., Moore, R. J. and Peterson, W. H., *Inst. Spokesman 13*, No. 12, 12 (1950).
5. Boner, C. J. in "Colloid Chemistry," edited by J. Alexander, Reinhold Publishing Corp., New York, 1946, Vol. VI, p. 553.
6. Browning, G. V., *Inst. Spokesman, 14*, No. 1, 10 (1950).
7. Doscher, T. M. and Vold, R. D., *J. Am. Oil Chem. Soc., 26*, 515 (1949).
8. Ellis, S. G., *Can. J. Research, A25*, 119 (1947).
9. Farrington, B. B. and Birdsall, D. H., *Inst. Spokesman, 11*, No. 1, 4 (1947).
10. Farrington, B. B. and Birdsall, D. H., *Oil and Gas J., 45*, 268 (1947).
11. Farrington, B. B. and Davis, W. N., *Ind. Eng. Chem., 28*, 414 (1936).
12. Gallay, W. and Puddington, I. E., *Can. J. Research, B21*, 211, 225 (1943).
13. Gallay, W. and Puddington, I. E., *Can. J. Research, B26*, 155 (1948).
14. Gallay, W., Puddington, I. E. and Tapp, J. S., *Can. J. Research, B22*, 66 (1944).
15. Gray, V. R., *Trans. Faraday Soc., 42B*, 196 (1946).
16. Gray, V. R. and Alexander, A. E., *J. Phys. Colloid Chem., 53*, 9, 23 (1949).
17. Hattiangdi, G. S., Vold, M. J. and Vold, R. D., *Ind. Eng. Chem., 41*, 2320 (1949).
18. Lawrence, A. S. C., *J. Inst. Pet. Tech., 24*, 207 (1938).
19. Lawrence, A. S. C., *Trans. Faraday Soc., 34*, 660 (1938).
20. Lawrence, A. S. C., *J. Inst. Petroleum, 31*, 303 (1945).
21. Lawrence, A. S. C., *J. Phys. Colloid Chem.*, 52, 1504 (1948).
22. Lloyd, D. J., in "Colloid Chemistry," edited by J. Alexander, Reinhold Publishing Corp., New York, 1926, Vol. I, p. 767.
23. Marsden, S. S., Mysels, K. J. and Smith, G. H., *J. Colloid Sc., 2*, 265 (1947).
24. Marton, L., McBain, J. W., and Vold, R. D., *J. Am. Chem. Soc., 63*, 1990 (1941).
25. McBain, J. W. and McClatchie, W. L., *J. Am. Chem. Soc., 54*, 3266 (1932).
26. McBain, J. W., Mysels, K. J. and Smith, G. H., *Trans. Faraday Soc., 42B*, 173 (1946).
27. McBain, J. W., and Working, E. B., *J. Phys. Colloid Chem., 51*, 974 (1947).
28. McGee, C. J., *J. Am. Chem. Soc., 71*, 278 (1949).
29. McRoberts, T. S. and Schulman, J. H., *Nature, 162*, 101 (1948).
30. Mysels, K. J., *J. Colloid Sc., 2*, 375 (1947).
31. Mysels, K. J. and McBain, J. W., *J. Phys. Colloid Chem., 52*, 1471 (1948).
32. Ostwald, W. and Riedel, R., *Kolloid-Z., 70*, 67 (1935).
33. Sheffer, H., *Can. J. Research, B26*, 481 (1948).
34. Smith, G. H., Rogers, L. B. and Mysels, K. J., *J. Am. Oil Chem. Soc., 26*, 135 (1949).
35. Smith, T. D., Amott, E. and McLennan, L. W., *Inst. Spokesman, 14*, No. 4, 10 (1950).
36. Vold, M. J., Hattiangdi, G. S. and Vold, R. D., *Ind. Eng. Chem., 41*, 2539 (1949).

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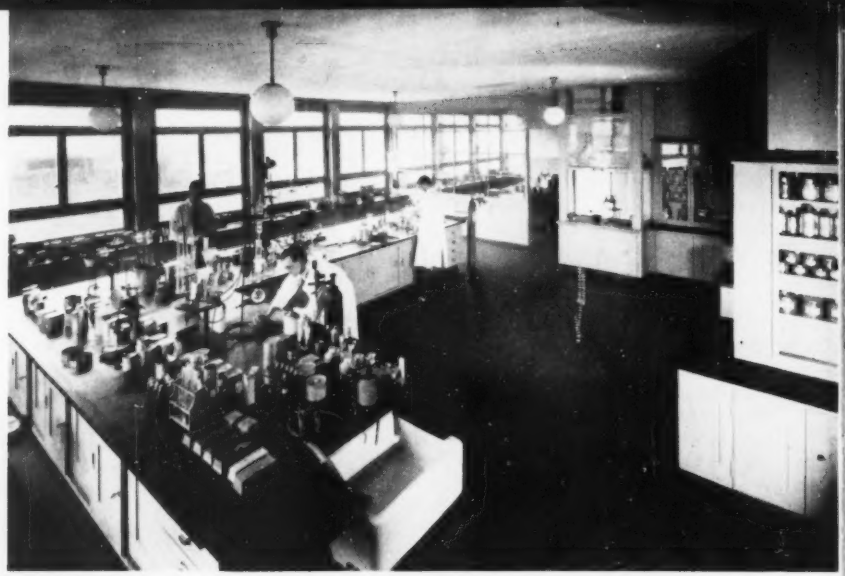

Installing one of the 12 20-ton tanks in the new addition.

The new addition which goes two stories below ground. On top is a tank battery for oils.

This view shows the main entrance to the plant.

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The History of N. L. G. I.'s First European Member

In 1884 Adolf Schmid, the descendant of a family having its home for many centuries at Wimmis in the Bernese Oberland, started a small business to supply the agricultural districts of the Canton of Berne with the various primitive lubricants needed at that time. Eventually he added other products such as animal and vegetal fats and oils, petrol, paints, etc. and extended his market beyond the borders of the Canton of Berne. After his death his heirs carried on the business but were not personally active in it. All went well until after World War I when the economic after-effects brought the business down to the extent that the Schmid family decided to sell it. In 1925 the heirs of the founder sold what was left of the old company to a small group of enterprising people who started practically from scratch to build up today's company: Adolf Schmids Erben, Incorporated.

The new owners decided to specialize in the manufacture and sale of all industrial lubricants, and they set high standards for quality and service, and pledged themselves to strict observance of the highest standard of business principles. The beginning was difficult but gradually the business grew and extended its activity even beyond the borders of the country. Today Adolf Schmids Erben, Inc. is the leading Swiss manufacturer of high quality lubricants and metal working products. Its laboratories are the largest and best equipped in Switzerland and its chief chemist and works manager, Mr. W. F. Pauk, is the author of several books on lubrication. In 1928 the manufacturing of bituminous emulsions for road building purposes was started and this branch of the company's activities also belongs to the top ranking producers of bituminous emulsions in the country.

Today the company employs a staff of 85, including chemists, engineers and a competent sales force. The managing director, Hermann P. W. Wanner, has been with the company since its incorporation in 1925.

Adolf Schmids Erben, Inc. is the exclusive distributor in Switzerland for the Pennzoil Company, Inc., Oil City, Pennsylvania, for the silicone oils and greases of the Dow Corning Corporation, Midland, Michigan, and for the Acheson Colloids Limited, London, England.

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Patents and Developments

WIRE ROPE LUBRICATING GREASES

The lubrication of wire ropes and cables presents peculiar problems because these products must be protected against internal corrosion and internal friction by a lubricating material which must not exude too freely, which must not be subject to excessive evaporation and which, at the same time, must afford adequate lubrication between the relatively movable fibers or wires and protect them from the elements.

Particular problems have arisen in the lubrication of cables which are subjected to extremes of temperatures. Thus, the control cables used in aircraft are subjected at times to extremely low temperatures and, inasmuch as their proper operation is extremely vital, and the metals themselves are not subject to increased fatigue at lower temperatures, considerable difficulty has arisen in securing their proper lubrication and operation.

When wire cables of any usual type are passed around sheaves, pulleys, etc. of relatively small radius of curvature, extremely high unit stresses are imposed on the individual wires, which stresses may exceed 100,000 psi in extreme cases, and extremely high frictional resistance to flexure may be encountered. Hence, it is essential that cable lubricants have extreme pressure characteristics and good oiliness properties. Also, they should prevent internal rusting.

Some wire ropes and cables are formed with a soft center of hemp or other fibrous material, and a common method of lubrication is to saturate the soft core with the lubricant which will continue to be passed out through the outer layers of wire by capillary action during the life of the cable, at such a rate that internal friction is minimized and rust and wear are reduced as far as possible.

In U. S. patent 2,556,289, Standard Oil Development Company discloses a preferred composition for this purpose which comprises a mineral base oil of 35-200 S.S.U. viscosity at 210°F with a thickener, a rust inhibitor, an extreme pressure additive, and a stabilizer. The thickener is preferably 3-15% by weight of an alkali metal soap of C_{12}-C_{22} fatty acids, preferably saturated. The rust inhibitor is a combination of an oil-soluble petroleum sulfonate and an animal wax or ester such as degras, about 1-5% by weight of sulfonate of 400 or higher molecular weight, with 1-5% of degras. Degras is an ester wax wherein the alcohol constituent is a mixture of sterols. Sodium nitrate and similar rust inhibitors also may be added.

About 1-10% of lead oleate is added for extreme pressure and oiliness properties, along with 3-12% of a sulfurized oily product, such as sulfurized hydrocarbons, fatty oils, ester waxes, etc., provided they are not corrosive to ferrous metals. A preferred stabilizer consists of 0.15-2% of an amphoteric metal soap, such as zinc or aluminum naphthenate, or a mixture of both. Conventional antioxidants, such as phenyl alpha naphthylamine likewise may be added.

One satisfactory composition given as an example consists of:

13.0%	"Hydrofol Acids 51"
2.05%	Lithium hydroxide monohydrate
0.50%	Zinc naphthenate
0.50%	Aluminum stearate
0.50%	Phenyl alpha naphthylamine
6.00%	50-50 mixture of oil soluble sulfonate and degras
7.50%	50-50 oil solution of sulfurized sperm oil
69.95%	Naphthenic type mineral oil having 500 S.S.U. vis./100°F.

The cold grease produced is worked to the desired penetration and the corrosion-preventive base and extreme pressure base are worked into the mass. The final product has the following inspections:

ASTM dropping point	350°F
Penetration worked (77°F)	300

Figure 1 shows a comparison of the above lubricant (Lubricant H) with a prior art cable lubricant "A" when applied to a 5/32" 7-strand (19 wires/strand) preformed aircraft cable of carbon steel which was tinned and hot galvanized on final sizing. This cable was passed around a sheave having a diameter 12 times that of the cable with a cable tension of 1% of the calculated breaking strength. Each cable was subjected to 12 hrs. exposure to 20% salt spray and was reversed hundreds of thousands of times before failure. The prior art lubricant "A" showed a much inferior corrosion fatigue life.

The lithium soap greases are definitely preferred where cables are exposed either to the open elements or to conditions of moisture condensation.

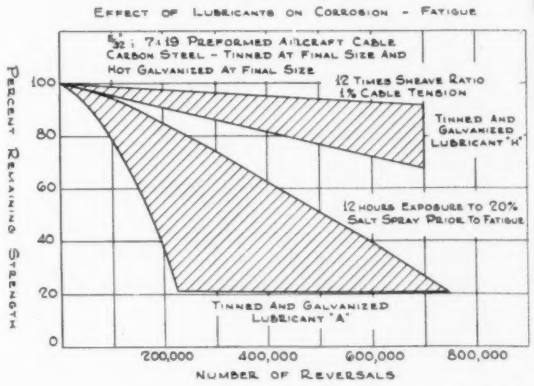
RHEOLOGICAL PROPERTIES OF A LUBRICATING GREASE

It is shown that when the phenomena of flow in a capillary are separated from concomitant effects (such as piston drag, entrance losses, and temperature rise during flow), a shear-stable grease of the 14G8 type behaves substantially as a Bingham plastic whose flow can be specified in terms of yield value and mobility (Singleterry et al, J. Colloid Sci. 4/51, P. 171).

SILICONE GREASES

Development of extreme temperature lubricating greases from silicones and silicone-diester mixtures (Merker et al, Bibl. Tech. Repts. 6/15/51, P. 171).

(*Continued on Page* 27)



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Technical Committee Column

Chairman T. G. Roehner, Director of the Technical Service Department, Socony-Vacuum Laboratories

A number of constructive suggestions have been received regarding items for the meeting of the Technical Committee on the third day of the forthcoming meeting of NLGI in Chicago. At the present date the agenda lists the following items:

1. Report from Dr. Vold on progress made by the NLGI Research Fellowship.

2. Review of activities of ASTM and other organizations working on problems involving lubricating greases.

3. Reports from Subcommittees of the NLGI Technical Committee, as follows:

Mr. L. C. Brunstrum, Chairman, Panel on Delivery Characteristics of Dispensing Equipment for Lubricating Greases.

Mr. L. W. McLennan, Chairman, Research Fellowship Subcommittee.

Dr. E. W. Adams, Chairman, Editorial Subcommittee.

Mr. C. J. Boner, Chairman, Subcommittee on the Procurement of Technical Papers for Publication in The Institute Spokesman.

Mr. H. L. Hemmingway, Chairman, Subcommittee on NLGI Classification of Greases.

4. Report of the status of projects of the Joint Committee on Lubricating Greases for Antifriction Journal Bearings and the ABEC-NLGI Cooperative Committee on Grease Test Methods.

5. Under the heading of New Business, the following proposals will be discussed to determine whether they should be established as new projects:

(A) Preparation of a dictionary of terms peculiar to the grease industry.

(B) Compilation of test methods involving lubricating greases.

PATENTS AND DEVELOPMENTS

(*Continued from Page* 25)

SILVER SOAPS

A study of some of the properties of silver soaps was made by Cheremisinoff. Fatty acid and hydroxystearic acid soaps were found to soften at 130°-156° C. The tan, almost white products were found to gel in xylene at 70-90° C. Introduction of the hydroxy group into the stearate prevented gelling altogether. Other soaps gave heavy gels with generally good stability (J. Amer. Oil Chem. Soc. 6/51, P. 278).

DEVELOPMENTS IN METALLIC SOAPS

Licata of Metsap Chemical Co. discusses mainly stearate soaps in an article on their properties and various uses (Paint, Oil & Chem. Rev. 6/21/51, P. 16).

PATENTS

U. S. 2,553,861 (Miller)—Grease gun coupling connector.

U. S. 2,555,532 (Chinchole)—Grease dispenser with means for jarring grease from container to pump chamber.

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Acid Value	201 - 203
Iodine Value (WIJS)	3 max.

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TWO NEW VICE PRESIDENTS ELECTED BY BROOKS OIL COMPANY

At the 75th annual stockholders and directors meeting of the Brooks Oil Company, of Cleveland, Pittsburgh and Hamilton, Ontario, two new vice-presidents were elected, according to an announcement by Fred H. McCurdy, president. Henry W. Winkler was elected Vice-President in Charge of Research and Laboratory Control, while Joseph A. Rigby was named Vice-President in Charge of Engineering and Sales.

Prior to his election as vice-president, Mr. Winkler had been for eight years Chief Chemist of the company. A native of Oil City, Pennsylvania, and a graduate of Allegheny College, Mr. Winkler was associated for many years with Dr. P. H. Conardson who developed testing techniques for petroleum lubrication oils and greases. For 37 years he has been connected with the production of industrial lubricants, specializing in recent years in lead base lubricants. Before joining Brooks Oil he was associated with Atlantic Refining Company, Galena Oil Corporation and Valvoline Oil Company. He is a member of the National Lubricating Grease Institute.

Before being named vice-president, Mr. Rigby had been Manager of Engineering and Sales. Prior to joining Brooks Oil in 1944, he was Assistant Superintendent of Maintenance of the Clairton Works of U. S. Steel Corporation. He is a member of Association of Iron & Steel Engineers, American Society of Lubricating Engineers, Engineers Society of Western Pennsylvania and National Lubricating Grease Institute.

SWAN-FINCH APPOINTS MANNING SALES PROMOTION MANAGER

Howard F. Moncrieff, President, Swan-Finch Oil Corporation, New York, N. Y., has announced the appointment of Daniel J. Manning, Jr., as Sales Promotion Manager. Mr. Manning, formerly Assistant Purchasing Agent, has been associated with the company since 1948.

HENRY W. WINKLER
Vice President
Brooks Oil Company

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For the pure, dark grades of Petrolatums needed for maintaining uniformity and high quality in your greases, specify Penn-Drake. Made of 100% Pennsylvania crude, they will not melt, sweat or become runny even at high temperatures. *May we send samples?*

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DEEP ROCK PROMOTIONS

B. L. Majewski, marketing vice president of Deep Rock, makes the following announcements from Chicago, Illinois.

Deep Rock Oil Corporation is moving its general sales office from Chicago to Tulsa, Oklahoma. Transfer of personnel is underway, but the entire move will not be accomplished until September. Purpose of the change is to headquarter all major divisions of the company in one location. The sales office is the only major Deep Rock division not already in Tulsa. Tom Murphy, general sales manager for Deep Rock, is the first sales executive to make the move. He is now located in the company's Atlas Life Building headquarters.

Burt A. Brokaw, formerly director of Minnesota's Department of Taxation petroleum division, is joining Deep Rock Oil Corporation in the newly created position of jobber operations specialist. He will utilize his 13 years of petroleum marketing and tax experience to assist Deep Rock's independent jobbers with their operating problems. Brokaw will be headquartered in Deep Rock's general sales office, Tulsa, Oklahoma.

W. J. Fuchs, formerly vice president of Winius-Brandon advertising agency in St. Louis, has joined the marketing division of Deep Rock Oil Corporation as advertising and sales promotion manager. For the past 13 years, Fuchs has handled numerous large accounts for Winius-Brandon in New Orleans and St. Louis. His two years as account executive for Deep Rock placed him in close contact with the company's operations. Fuchs plans to establish his residence in Tulsa, Okla., in the near future.

Ralph B. Heuring has been promoted to manager of the newly created Des Moines sales district of Deep Rock Oil Corporation with offices at Room 304, Walnut Building. In his new capacity, Heuring will be in charge of all Deep Rock jobbing sales in the Des Moines district, which covers the states of Iowa and Nebraska. The new district manager entered active sales work in 1929 when he became assistant division manager of Deep Rock's Western Area. He was promoted to area sales manager in 1950, the job he held before his present promotion.

Andrew M. Oleston has been promoted to manager of the newly created Minneapolis sales district of Deep Rock Oil Corporation with offices at 84 South Sixth St. He will be in charge of all Deep Rock jobbing sales in the Minneapolis district, which covers most of Minnesota and northwestern Wisconsin. From his first job as traveling collector, Oleston worked up through the Deep Rock organization to become Northwest Area Sales Manager. This is the job he held before his present promotion.

Elmer Wickum has been promoted to manager of the newly created Fargo (N. Dak.) Sales District of Deep Rock Oil Corporation with temporary offices at Moorhead, Minn. Wickum, who started his Deep Rock career in 1928, will be in charge of all Deep Rock jobbing sales in the Fargo district, which covers North and South Dakota and the northwest corner of Minnesota. He was Northwest Area Jobbing Salesman, before promotion to his new position.

Leigh S. McCaslin, Jr., has joined the marketing division of Deep Rock Oil Corp. This new Deep Rock employee received his second college degree this past year. Oklahoma A. and M. granted him a professional degree in mechanical engineering. McCaslin and his wife have reestablished residence in Tulsa, Oklahoma.

In conjunction with Deep Rock Oil Corporation's expanded land and exploration program, Vice President John L. Ferguson, Tulsa, Oklahoma, has announced several personnel changes and additions, and the opening of two new offices.

All Oklahoma operating activities of the division are now consolidated in an Oklahoma City office under the supervisions of Area Geologist O. E. Gram and Area Landman L. L. Crozier. Charles D. Moore, formerly with Stanolind Oil and Gas Co., also has been added to the Oklahoma City staff as geologist. H. L. Curry and R. W. Bayliss will continue to handle scouting activities from the new location.

In the division's headquarters at Tulsa, Charles W. Lane, who has been area geologist for southern and western Oklahoma and assistant to the geology manager, has been appointed technical and administrative assistant to the vice president. I. S. Higginbotham, longtime Deep Rock employee and recently Tulsa area geologist, has been named new assistant to the geology manager.

Geophysical Manager C. J. Harvey gained an assistant manager, Harry M. Cooper, Jr., a graduate of Ohio State University and Carnegie Tech, who comes to Deep Rock with varied seismic experience.

Robert D. Gensch, also a former Tulsa area geologist, has moved to Wichita, Kansas, as area geologist to reopen the company's offices in the Petroleum Building of that city. Kenneth Holke, recently with Cooperative Refinery Association, joins the new office as assistant geologist.

In the Rocky Mountain area, the Sterling, Colorado, office is being closed and a new one opened at Casper, Wyoming. Former Sterling Geologist R. J. Field and Scout R. G. Boekel are being moved to Denver while Scout and Landman M. R. Reston has been transferred to Casper. The Denver office is headed by Area Geologist W. C. MacQuown and Landman E. E. Nowell.

H. G. BRATT

CONTINENTAL CAN PROMOTES H. G. BRATT

H. G. Bratt recently was appointed general manager of manufacturing, Metal Division, for Continental Can Company, according to T. C. Fogarty, executive vice president of Continental's Metal Division.

Mr. Bratt formerly was manager of manufacturing for Continental's Pacific division and prior to that was general manager of its Cuban division. He has been with Continental since 1943 and, in his new position, replaces L. C. Walgash who resigned from the company in July.

FUTURE MEETINGS of Your Industry

SEPTEMBER, 1951

3-7 American Chemical Society (120th national Diamond Jubilee meeting), Hotel Statler, New York, N. Y.

5-8 Oil Industry Information Committee, Waldorf - Astoria Hotel, New York, N. Y.

6-7 Michigan Petroleum Assn. (annual fall convention), Ramona Park Hotel, Harbor Springs, Mich.

8-9 International Union of Pure and Applied Chemistry (16th conference), Hotel Statler, New York, N. Y.

10-13 International Congress of Pure & Applied Chemistry (12th conference), Hotel Statler, New York, N. Y.

10-13 Socy. of Automotive Engineers, Inc. (national tractor meeting and production forum), Hotel Schroeder, Milwaukee, Wisc.

12 American Petroleum Institute (Lubrication Committee business meeting), The Traymore, Atlantic City, New Jersey.

12-14 National Petroleum Assn., Hotel Traymore, Atlantic City, N. J.

14-15 International Union of Pure and Applied Chemistry (16th conference), Hotel Statler, Washington, D. C.

14-16 Petroleum Marketers Assn. of Texas (second annual convention), The Shamrock, Houston, Texas.

20-21 Western Petroleum Refiners Assn. (regional meeting), Henning Hotel, Casper, Wyo.

24-25 American Assn. Oilwell Drilling Contractors (11th annual meeting), Hotel Texas, Fort Worth, Texas.

24-26 American Socy. of Mechanical Engineers (6th petroleum mechanical engineering conference), Mayo Hotel, Tulsa, Okla.

24-26 Independent Oil Compounders Assn., (4th annual meeting), Hotel Detroit-Leland, Detroit, Michigan.

25-28 The American Socy. of Mechanical Engineers (fall meeting), The Radisson, Minneapolis, Minn.

OCTOBER, 1951

3-6 Socy. of Automotive Engineers, Inc. (national aeronautic meeting, production forum, and aircraft engineering display), The Biltmore Hotel, Los Angeles, Calif.

8-9 Texas Mid-Continent Oil & Gas Assn. (annual meeting), Hotel Beaumont, Beaumont, Texas.

8-10 The American Oil Chemists' Socy. (fall meeting), Edgewater Beach Hotel, Chicago, Ill.

8-12 National Safety Council (39th national safety congress and exposition), Stevens Hotel, Chicago, Ill.

13-14 Indiana Independent Petroleum Assn. (fall convention), Hotel Severin, Indianapolis, Ind.

14-20 Oil Progress Week.

22-23 Independent Petroleum Assn. of America (annual meeting), The Shamrock, Houston, Texas.

22-24 American Standards Assn. (33rd annual meeting and national standardization conference), Waldorf-Astoria, New York, N. Y.

29-30 Socy. of Automotive Engineers, Inc. (national diesel engine meeting), The Drake, Chicago, Ill.

29-31 Socy. of Automotive Engineers, Inc. (national transportation meeting), Knickerbocker Hotel, Chicago, Ill.

"--AND HERE'S MORE GOOD NEWS, MOTHER--I'M GOING WITH GEORGE TO THE N.L.G.I. MEETING IN CHICAGO ON OCTOBER 29TH AT THE EDGEWATER BEACH--WE'LL HAVE A WONDERFUL TIME!"

29-31 N.L.G.I. (annual meeting), Edgewater Beach Hotel, Chicago, Ill.

31 to Nov. 1 Socy. of Automotive Engineers, Inc. (national fuels and lubricants meeting), The Drake, Chicago, Ill.

NOVEMBER, 1951

3-8 Oil Industry Information Committee, Stevens Hotel, Chicago, Ill.

5-8 American Petroleum Institute (31st annual meeting), Palmer House, Chicago, Ill.

5-8 A. P. I. Lubrication Committee, Chicago, Illinois.

25-30 The American Society of Mechanical Engineers (annual meeting), Chalfonte-Haddon Hall, Atlantic City, N. J.

26 to Dec. 1 23rd Exposition of Chemical Industries, Grand Central Palace, New York, N. Y.

FUTURE MEETINGS of Your Industry

DECEMBER, 1951

2-5 American Inst. of Chemical Engineers (annual meeting), Chalfonte-Haddon Hall, Atlantic City, N. J.

3-4 Chemical Specialties Mfrs. Assn. (38th annual meeting), The Mayflower, Washington, D. C.

26-31 American Assn. for the Advancement of Science (annual meeting), The Bellevue-Stratford, Philadelphia, Pa.

★

JANUARY, 1952

14-18 Socy. of Automotive Engineers, Inc. (annual meeting), Hotel Book-Cadillac, Detroit, Mich.

FEBRUARY, 1952

4-6 Missouri Petroleum Assn. (annual convention and trade exhibit), Jefferson Hotel, St. Louis, Mo.

19-21 Iowa Independent Oil Jobbers Assn. (annual convention), Fort Des Moines, Des Moines, Iowa.

MARCH, 1952

3-5 Mfrs. Standardization Socy. of Valve & Fittings Industry(annual meeting), Hotel Commodore, New York, N. Y.

12-13 Texas Oil Jobbers Assn., Inc. (annual spring convention and refiners & suppliers exhibit), Hotel Adolphus, Dallas, Texas.

11-14 National Assn. of Corrosion Engineers (annual conference and exhibition), Municipal Pier and Galvez Hotel, Galveston, Texas.

APRIL, 1952

7-9 American Society of Lubrication Engineers (7th annual meeting and lubrication show), Hotel Statler, Cleveland, Ohio.

JUNE, 1952

9-10 Chemical Specialties Mfrs. Assn. (38th mid-year meeting), Hotel Statler, Detroit, Mich.

23-27 American Socy. for Testing Materials (annual meeting), Hotel Statler, New York, N. Y.

OCTOBER, 1952

20-24 National Safety Council (40th national safety congress and exposition), Stevens Hotel, Chicago, Ill.

NOVEMBER, 1952

10-13 American Petroleum Institute (32nd annual meeting), Stevens Hotel and Palmer House, Chicago, Ill.

30 to Dec. 5 American Socy. of Mechanical Engineers, New York, N. Y.

DECEMBER, 1952

1-6 20th National Exposition of Power & Mechanical Engineering, Grand Central Palace, New York, N. Y.

8-9 Chemical Specialties Mfrs. Assn. (39th annual meeting), Hotel New Yorker, New York, N. Y.

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Backed by the World's Greatest Lubrication Knowledge and Engineering Service

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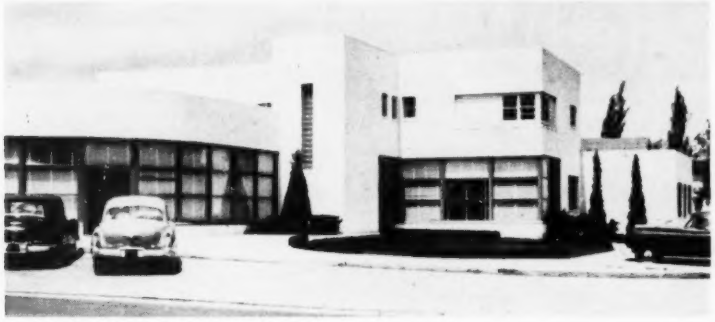
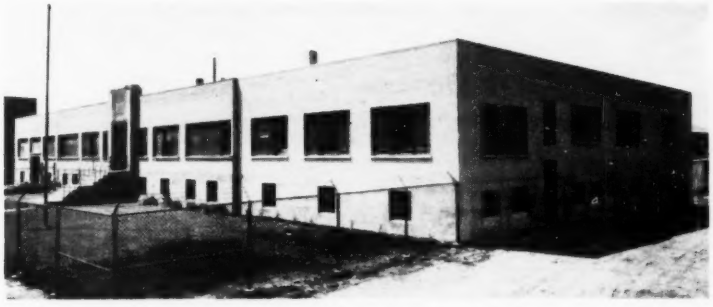
Your Industry NEWS





Above: A new laboratory for research on carbon black has been completed and put into operation in Amarillo, Texas by the Continental Carbon Company, for whose products Witco Chemical Company is the sole distributor. The laboratory is designed to extend the company's facilities for the improvement of existing processes in the production of carbon black as well as experimental work on new products in the field. Research will be carried out on channel blacks, furnace blacks, and oil blacks.

Below: The newly finished wing of the Chicago Laboratories of the Witco Chemical Company has doubled the research facilities of the laboratories and has made it possible to greatly enlarge the staff. The new laboratory will permit increased research on organic chemicals such as esters, stabilizers, metallic soaps, and paint driers as well as developmental work on present processes.

JUDGING COMPLETED IN FOOTE MINERAL COMPANY "LITHIUM" AWARD PROGRAM

Foote Mineral Company reports that A.C.S. judges have selected the top eight papers in its "Lithium" Award Program.

Charles S. Pearce, General Secretary of the American Ceramic Society and Secretary of the Award Committee turned over the list of winners and their papers to Foote executives early this week. Names and awards will be officially announced October 12 when contestants journey to Corning, New York, as guests of Foote at the Glass Division Meeting of the American Ceramic Society. Presentation of certificates and checks totalling $1,000.00 will be made at that time.

The Foote "Lithium" Awards have a two-fold purpose: (1) to stimulate scientific research in the use of lithium and (2) to make results of this research generally available. Regulations governing the awards specifically state that the papers must deal with ceramics and involve the use of any natural or manufactured lithium compounds and their contributing benefits.

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QUALITY GREASE MAKING
- Neutral Oils
  Viscous and Non-Viscous
- Bright Stock
- "G" Cylinder Stock
  UNIFORM, DEPENDABLE

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AMERICAN LUBRICANTS, INC. REMAINS INDEPENDENT

AMERICAN LUBRICANTS, INC. of Buffalo, New York, has been involved in a rumor which has no basis in fact. Unfortunately, the rumor has been circulated widely, and leads many to believe that this smoke must be associated with something flammable. The situation calls for some clarification.

AMERICAN LUBRICANTS, INC. has been in business and independent for over a quarter of a century. This circumstance has never changed.

However, the name "American" has been used widely in the petroleum industry. And the name "American Lubricants" is likewise used repetitively. "Thomas' Register of American Manufacturers" lists three companies by this name. Fortunately, the corporate names vary slightly. Thomas' Register shows "The American Lubricants Co.", "American Lubricants Co.", and "American Lubricants, Inc".

One of these three companies has recently been purchased by another lubricant manufacturing and distributing organization. Due to the similarity in names, there has been considerable misunderstanding, leading to many inquiries as to possible change in status.

AMERICAN LUBRICANTS, INC. continue to manufacture and supply quality lubricants to meet the requirements of other marketing, distributing, and consuming companies, rendering speedy convenient service in a spirit of friendship and independence—the same independence that has existed since the company was founded. In this there has been no change.

FANSHIER AND PETTY START OIL DAILY

Two men with names known throughout the petroleum world,—Keith J. Fanshier and Milburn Petty,—soon will launch, probably in September, "the national newspaper of petroleum," to be known as The Oil Daily, with headquarters in Chicago, at 111 West Washington Street.

For 25 years, Mr. Fanshier has had close association with the petroleum industry, having been petroleum editor of the Chicago Journal of Commerce. Mr. Petty for seven years has issued the Petty Oil Letter from Washington. The letter has attained an extensive distribution within the industry. Mr. Petty, of course, will continue issuance of the letter as his own publication.

"We can make The Oil Daily an editorial force for good of the industry and the public," says Mr. Petty. "It will be an independent newspaper serving everyone interested in petroleum. You can count on its news columns being just as free of editorializing, just as accurate and impartial as Petty's Oil Letter."

According to Mr. Fanshier, the Oil Daily, while a publication of independent thought and judgment, working to formulate sound leadership in the industry, will have its primary approach and its principal activity in the presentation of "news while it is news." Subscriptions are being accepted at $25 a year.

Physical Chemistry of LUBRICATING OILS

By A. Bondi

This volume gives you the latest theories on lubricating oils and the physical and chemical principles underlying their action. It is a broad and well documented treatment of specific problems in lubricant technology. Many inaccessible or widely scattered data and simple methods for the estimation of unknown properties from few given data will prove most valuable to engineers, physical chemists and all technical men in the lubrication field.

The author is an outstanding authority who has been working for many years with practical lubrication problems in the laboratory. He began writing papers on the physiochemical behavior of lubricants in 1936. This long experience, plus the author's endless quest for background information on lubricating problems, forms the basis for this useful book. It should contribute greatly to the solution of many basic problems that are still unsolved, particularly in wartime operation of airplanes and automotive equipment. Such properties as viscosity, pour point, oiliness, flowing characteristics, foaming, etc. are discussed in great detail and attention is given to additives of all types. An entire chapter is devoted to synthetic lubricants and there is an especially valuable section dealing with the reaction kinetics involved in lubrication problems.

This book makes an excellent companion to "Motor Oils and Engine Lubrication" by Carl Georgi published in 1950. The two books now constitute a thorough presentation of the latest information available on the theoretical and highly practical aspects of lubrication.

This book can be purchased from the N.L.G.I. for $10.00.

WITCO GREASE GRADE LEAD NAPTHENATE

A Grease Grade Lead Naphthenate manufactured by Witco Chemical Company in two metal concentrations, thirty and thirty-three per cent, is produced especially for applications in lead-grease lubricants and is effective due to its solubility and stability in lubricating oils and greases, its anti-corrosive properties, and its enhancing of film strength, oiliness, and anti-seize characteristics.

Solubility in mineral oils is excellent over a wide range of viscosities, and protection to iron, steel, and other metals is good against moisture, mild acids, and similar corrosives.

By itself, Witco Grease Grade Lead Naphthenate exhibits moderate extreme pressure properties, and, when used in combination with special extreme pressure additives, does not detract from the lubricant properties of the finished compound. In a typical lubricating oil of 120 SSU @ 210 degrees F., a 7.5 per cent concentration gives a Timken Test of 9,250 p.s.i. equivalent at 32 pounds maximum beam load.

For further information concerning Witco Grease Grade Lead Naphthenate, write to Witco Chemical Company, 295 Madison Avenue, New York 17, New York.

LUBRICATE FOR SAFETY EVERY 1000 MILES

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Monsanto SANTOLENE C stops corrosion

It's easy to prevent corrosion in tanks and drums used to store or transport gasoline, kerosene, fuel oil and other light petroleum products. Just add a minute quantity of Santolene C, Monsanto's rust inhibitor. For details on the use of Santolene C, write MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second St., St. Louis 4, Missouri.

TESTS PROVE that Santolene C stops corrosion. Results of tests, at various concentrations of the additive in fuel oil, are illustrated. (A) No Santolene C. (B) 10 ppm Santolene C. (C) 20 ppm Santolene C. Similar results have been obtained by tests in other light petroleum products.

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Sometimes it's hard to choose

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The name INLAND is your best guarantee of perfect protection

That's the first consideration, perfect protection for your product . . . in transit, in storage, on the shelf — right up to the moment it is opened for use. And there's no better safeguard than Inland Steel Containers, the most durable drums and pails made anywhere today.

They're leakproof, sift-proof, air-tight — available with colorful Inland lithography or printing for added sales appeal. Write for complete information, and remember — it's better to ship in steel — and best to specify Inland Steel Containers.

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With Research Comes Quality, With Quality Comes Leadership.

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how to keep grease quality

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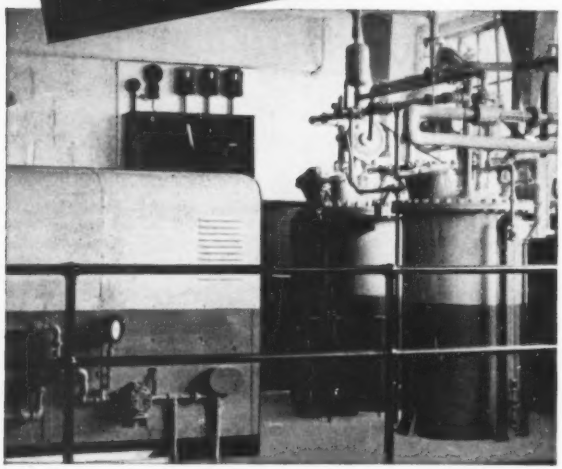

KEEPING grease uniform is a painstaking task with batch methods. But with VOTATOR Grease-making Apparatus uniformity is maintained automatically.

That's because VOTATOR Grease-making Apparatus processes continuously—always under precise, automatic control. Moisture content—important to grease luster and clarity—can be controlled accurately. Grease can be delivered for packaging always at the right temperature.

VOTATOR Grease-making Apparatus can be applied for processing of many types of greases. Write now for case history facts. The Girdler Corporation, Votator Division, Louisville 1, Ky.

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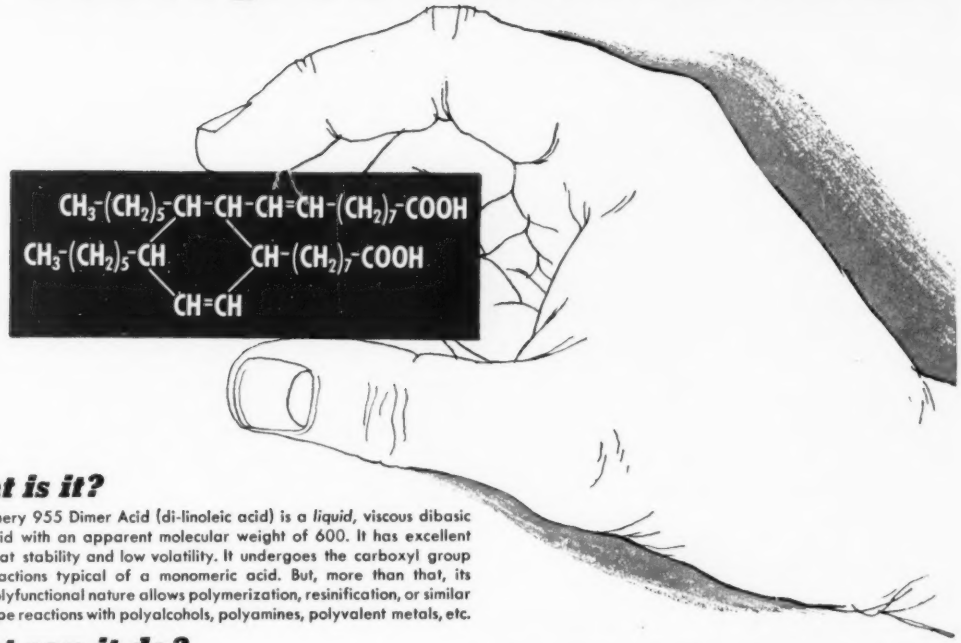
How can you use this unique Emery 955 Dimer Acid?



what is it?

Emery 955 Dimer Acid (di-linoleic acid) is a *liquid*, viscous dibasic acid with an apparent molecular weight of 600. It has excellent heat stability and low volatility. It undergoes the carboxyl group reactions typical of a monomeric acid. But, more than that, its polyfunctional nature allows polymerization, resinification, or similar type reactions with polyalcohols, polyamines, polyvalent metals, etc.

what can it do?

The applications of Dimer Acid are many and varied. It forms both soluble and insoluble soaps; long chain, rubber-like polyesters; low melting point, water-resistant polyamide resins, etc.

Esters of short chain, monohydric alcohols show promise as components of relatively low-cost di-ester base oils and greases. For example, the di-butyl ester is characterized by a low pour point (–50°F.), high flash point (530°F.), and possesses an exceptionally good temperature-viscosity curve.

Tested for 2 Years

Because the utility of Dimer Acid (formerly designated Emery M-461-R) has been firmly established in many diversified fields during the past two years, and commercial production standardized, it has now been transferred to the Chemical Sales Division as a standard product with the new designation, Emery 955 Dimer Acid. The success of its many unique properties has been proven in many commercial products and may give you competitive advantages you have never thought possible.

Typical Characteristics

Iodine Value	80-95
Acid Value	180-192
Neutralization Equivalent	290-310
Color, Gardner	12 max.
Unsaponifiable	2.0% max.
Viscosity, Gardner	Z4

Get the complete, detailed story of this remarkable Emery Dimer Acid. Mail the coupon now . . . for Emery's new, informative Dimer Acid booklet.

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More Foote lithium chemicals are on the way . . .
Our high grade ores at Kings Mountain, North Carolina
already are feeding the Foote Exton processing plant which
is being expanded to increase capacity materially . . .
for more and better ceramic products, multi-purpose
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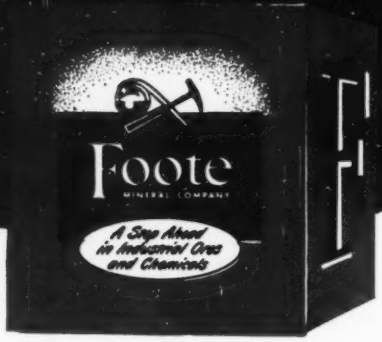

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